

TEXTURE BASED CONTENT RETRIVAL FOR Brain IMAGE USING FILTER TECHNIQUE

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Abstract:

The image can be segmented into homogenous areas by many different ways. In this paper the program was used to divided the image which is Texture based on color. The images used in this paper were the MRI (Magnetic Resonance Image) of a healthy person and other images of sick person, had the diseases. The colored images MRI were divided into many areas according to the colors by using three filters .i.e. Entropy filter, standard deviation (STD) filter, and Range filter where the colored image was changed into gray one.

Keywords: STD filter, Range filter, entropy filter.

طريقة النسيج المعتمدة على معالجة صورة الدماغ باستخدام تقنية الفلاتر

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الخلاصة:

ان عملية تقسيم الصورة إلى مناطق متجانسة يتم بطرق مختلفة ، وفي هذا البحث استخدمت خوارزمية ببرنامج الماتلاب لتقسيم الصورة وهي طريقة القوام المعتمدة على اللون . وادخلت صور الرنين المغناطيسي لشخص سليم و اخر مصاب بنفس المرض وقورنت نتائج هذا البرنامج بين الشخص المصاب والشخص السليم إذ قسمت إلى مناطق حسب الألوان باستخدام ثلاثة فلاتر هي الانتروبي (Entropy) مقياس (Standard Deviation STD) من المدى (Range Filter) إذ حولت الصورة الملونة إلى رمادية.

الكلمات المفتاحية: STD فلتير، فلتير المدى ، فلتير الأنتروبي

1. Introduction

Metal-Phthalocyanine find extensive

Images are divided by segmentation which is an important tool in medical image processing [1]. It could be used in a preliminary step for compression and

visualization. By means of identification of all pixels, Its segmentation is achieved[2]. Segmentation is crucial for feature extraction, display and measurement of image [3]. In MRI medical imaging. MRI (Magnetic Resonance Image) of brain has been given the most significance as MRI is

self-distinguished from other modalities . It can be apply it to manifold sclerosis, split personality, seizure, Parkinson's disease, Alzheimer, and cerebral atrophy[4]. Images are turned to edge images by edge detection techniques benefiting from changes of gray tone images. Edges are made of continuity loss and ending .The transformation outcome is obtaining edge image without changes of the physical properties [5].Texture is a property that represents the surface and structure of an image. Texture can be defined as a regular repetition of an element or pattern on a surface. Image textures arc complex visual patterns composed of entities or regions with sub-patterns with the characteristics of brightness, color, shape, size, etc. An image region has a constant texture if a set of its characteristics arc constant, slowly changing or approximately periodic[6]. Texture can be regarded as a similarity grouping in an image [8].

2. Types of statistical texture filtering

There are three statistical texture filtering functions which are.

1. Standard deviation (STD) filter:

Calculates the local standard deviation of an image.

2. Range filter:

Calculates the local range of an image.

3. Entropy filter:

Calculates the local entropy of a grayscale image.

The above filtering technique depends on the neighborhood around the pixel of interest and calculates the statistic for that neighborhood.

- 1- Standard Deviation Filter (STD): technique specify defining a neighborhood) around the pixel of interest and

calculating the statistic for the neighborhood to determine the pixel value in the output image. The (STD) filter function calculates the standard deviation of all the values in the neighborhood. The standard deviation of the pixels of neighborhoods is computed as follow.[8]

$$STD = \sqrt{\frac{\sum (x_i - \bar{x})^2}{rc - 1}} \dots\dots\dots (1)$$

Where:

x_i is the individual pixd values of input considered by the filter

\bar{x} is the mean of the pixel values considered by the filter

r : is the size of the filter in rows

c is the size of the filter in columns for each group of pixels in the input map, A standard deviation filter calculates the standard deviation and assigns this value to the center pixel in the output map.

- 2- Range Filter: (Find local range of image). Range filter is used to find edges within an image and works for only monochrome . In the range method, the color value of each pixel is replaced with the difference of maximum and minimum (i-e. the range) of color values of the pixels in a surrounding region. The range filter function uses a 3×3 neighborhood but can specify neighborhoods or different shapes and sizes. Determining Pixel Values in Range Filtered Output Image.

- 3- Entropy filter: An entropy filter of a small section of a noted

pixel (x, y) is calculated and said noted pixel (x, y) is renewed by an obtained entropy value. Filters image by replacing every value by the information entropy of the values in its range neighborhood. Using an entropy filter, a smooth portion image quality is extracted from an original image. The entropy filter technique specifies defining a neighborhood around the pixel of interest and calculating the statistic for the neighborhood to determine the pixel value in the output image. The entropy filter function calculates the entropy of the neighborhood and assigns that value to the output pixel. Note that, by default, the entropy filter function defines a 9×9 neighborhood around the pixel of interest. To calculate the entropy of gray scale image.[8]

$E = \text{entropy}(I)$

Description

$E = \text{entropy}(I)$ returns E, a scalar value representing the entropy of grayscale image I. Entropy is a statistical measure of randomness that can be used to characterize the texture of the input image. Entropy is defined as

$$-\sum p_i \cdot \log_2(p_i)$$

Where p contains the histogram counts returned from function in matlab. By default, entropy uses two bins for logical arrays and 256 bins for uint8, uint16, or double arrays.

Entropy (I) can be a multidimensional image. If Entropy (I) has more than two dimensions, the entropy

function treats it as a multidimensional grayscale image and not as an RGB image.[9].

2.1 Local entropy of gray scale image

$J = \text{Entropy filter}(I)$

$J = \text{entropy filter}(I, \text{NHOOD})$

Description

$J = \text{entropy filter}(I)$ returns the array j, where each output pixel contains the entropy value of the 9×9 neighborhood around the corresponding pixel in the input image I. Where I can have any dimension. If I has more than two dimensions, entropy filter treats it as a multidimensional gray scale image and not as a true color (RGB) image. The output image J is the same size as the input image. For pixels on the borders of I, entropy filter uses symmetric padding. In symmetric padding, the values of padding pixels are a mirror reflection of the border pixels in I.

$J = \text{entropy filter}(I, \text{NHOOD})$ performs entropy filtering of the input image I where you specify the neighborhood in Nhood. Nhood is a multidimensional array of zeros and ones where the nonzero elements specify the neighbors, Nhood size must be odd in each dimension. By default, entropy filter uses the neighborhood. Entropy filter determines the center element of the neighborhood by floor ((size (NHOOD) + 1)/2). To specify neighborhoods of various shapes, such as a disk, use the strel function to create a structuring element object and then use the getnhood function to extract the neighborhood \from the structuring element object. [9]

2.2 Local range of image.

$J = \text{range filter}(I)$

$J = \text{range filter}(I, \text{NHOOD})$.

Description

$J = \text{range filter}(I)$ returns the array J , where each output pixel contains the range value (maximum value - minimum value) of the 3×3 neighborhood around the corresponding pixel in the input image I . The image I can have any dimension. The output image j is the same size as the input image I ,

$J = \text{range filter}(I, \text{NHOOD})$ performs range filtering of the input image I where you specify the neighborhood in NHOOD . NHOOD is a multidimensional array of zeros and ones where the nonzero elements specify the neighborhood for the range filtering operation, NHOOD size must be odd in each dimension.

By default, range filter uses the neighborhood true (3). Range filter determines the center element of the neighborhood by floor ($(\text{size}(I, \text{NHOOD}))$). For information about specifying neighborhoods[8].

2.3 Local standard deviation of image

$J = \text{Std filter}\{I\}$

$J = \text{Std filter}(I, \text{NHOOD})$.

$J = \text{Std filter}(I)$

Description

returns the array where each output pixel contains the standard deviation of the 3×3 neighborhood around the corresponding pixel in the input image I . the image can have any dimension The output image is the same size as the input image I . For pixels on the borders of I . std filter uses symmetric padding In symmetric

padding, the values of padding pixels are a mirror reflection of the border pixels in I .

$J = \text{std filter}(I, \text{NHOOD})$ calculates the local standard deviation of the input image I . Where the user specifies, the neighborhood is a multidimensional array of zeros and ones where the nonzero elements specify the neighbors NHOOD 'S. size must be odd in each dimension. By default, std filter uses the neighborhood ones (3). Std filter determines the center element of the neighborhood by floor $\text{size}(\text{NHOOD} + 1 / 2)$, [9]

d

3. TEXTURE ANALYSIS:

The optical absorption spectra of thin films deposited at two different substrate It is a measure of the variation of the intensity of a surface, quantifying properties such as smoothness, coarseness; and regularity. It is often used as a region descriptor in image analysis and computer vision. Specifically, a textured region consists of a connected set of pixels that satisfy a given gray-level property which occurs repeatedly in an image region. [10]

Texture can be regarded as the visual appearance of a surface or material. Textures appear in numerous objects and environments in the universe and they can consist of very different elements[11]. Image analysis techniques have played an important role in several medical applications. In general, the applications involve the automatic extraction of features from an image which is then used for a variety of classification tasks; such as distinguishing normal tissue from abnormal tissue. Traditionally texture analysis problems are divided into four categories: texture, texture classification, texture synthesis and shape from texture. Typical machine vision problems are

usually related to the first two: segmentation and classification. The following subsections will offer a summary of what is meant with these two problem categories. [10] [12]

3.1 APPROACHES TO TEXTURE ANALYSIS

Mathematical procedures to characterize texture fall into two major categories.

1. Statistical
2. Syntactic

Statistical approaches compute different properties and are suitable if texture primitive sizes are comparable with the pixel sizes. These include Fourier transforms, convolution filters, co-occurrence matrix, spatial autocorrelation, fractals. Syntactic and hybrid (Combination of statistical and syntactic) methods are suitable for textures where primitives can be described using a larger variety of properties than just tonal properties; for example shape description. Using these properties, the primitives can be identified, defined and assigned a label. For gray-level images, tone can be replaced; with brightness.

3.2 STATISTICAL APPROACHES

Statistical methods analyze the spatial distribution of gray values, by computing local features at each point in the image, and deriving a set of statistics from the distributions of the local features [8]. The reason behind this is the fact that the spatial distribution of gray values is one of the defining qualities of texture. Statistical approaches yield characterizations of textures as fine, coarse etc. Thus one measure of texture is based on the primitive size, which could be the average area of these primitives of

relatively constant gray level. The average could be taken over some set of primitives to measure its texture or the average could be about any pixel in the image. If the average is taken within a primitive centered at each pixel in the image, the result can be used to produce a texture image in which a large gray level at a pixel indicates, for example, that the average primitive size is large in a region around that pixel. The average shape measure of these primitives, such as P^2/A , where P is the perimeter and A is the area of the primitive could also be used as texture measure.

3.3 First-order statistics based approach

First order texture measures are statistics calculated from the original image values, like variance, and do not consider pixel neighborhood relationships. Histogram based approach to texture analysis is based on the intensity value concentrations on all or part of an image represented as a histogram. Common features include moments such as mean, variance, dispersion, mean square value or average energy, entropy, skewness and kurtosis. Variance in the gray level in a region in the neighborhood of a pixel is a measure of the texture. The basic statistical approaches yield characterizations of textures as smooth, coarse, grainy, and so on. One of the simplest approaches for describing texture is to use moments of the gray-level histogram of an image or region. Structural approaches deal with the arrangement of image primitives. They use a set of predefined texture primitives and a set of construction rules to define how a texture region is constructed with the primitives and the rules. Spectral approaches to texture analysis techniques are based on properties of the Fourier spectrum, Gabor and wavelet based and are

used primarily to detect global periodicity in an image by identifying high energy, narrow peaks in the spectrum. Spectral techniques are ideally suited for describing the directionality of periodic, or almost periodic 2-D Patterns in an image. Texture is a difficult concept to represent. The identification of specific textures in an image is achieved primarily by modeling texture as a two-dimensional gray level variation. The relative brightness of pairs of pixels is computed such that degree of contrast, regularity, coarseness and directionality.

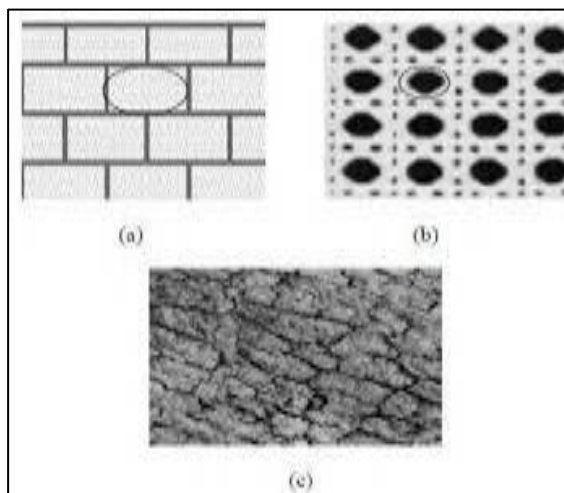


Fig. 1: different texture images (a,b,c)

Texture segmentation has several potential applications in image analysis, thus it has been studied extensively. Boundary based segmentation of texture images is usually a tougher task because texture edges can be very hard to detect. Both supervised and unsupervised segmentation methods have their own applications, but unsupervised texture segmentation has been found to be more suitable [13]. Supervised methods are often closely related to image classification [14].

4. The Texture Segmentation

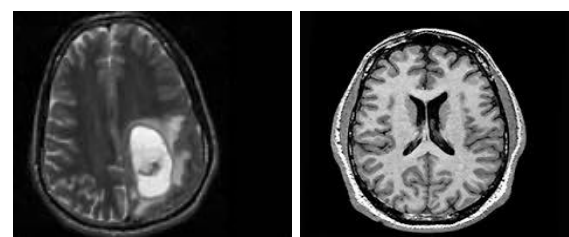
Texture analysis refers to a class of mathematical procedures and models that characterize the spatial variation within imagery as a means of extracting

information. Texture is an aerial construct that defines local spatial organization of spatially varying spectral values that is repeated in a region of larger spatial scale. Thus, the perception of texture is a function of spatial and radiometric scales. Descriptors providing measures of properties such as smoothness coarseness and regularity are used to quantify the texture content of an object. Since an image is made up of pixels, texture can be defined as an entity consisting of mutually related pixels and group of pixels. This group of pixels is called as texture primitives or texture elements (texels)[15]

5. Discussion of Results:

In this paper the results of the programs are discussed color texture, the aim of the paper is to perform image segmentation of MR Image by difference methods texture segmentation (normal and diseased) of human brain

Figure(1-2) shows Disease and normal MRI brain image, where (1.2.a) shows tumor brain and (1.2.b) shows normal brain.



a- Abnormalbrain b- Normal brain

**Fig.(3-2):MRI images: (a) Abnormal brain
(b) Normal brain**

The program was executed in the following steps:

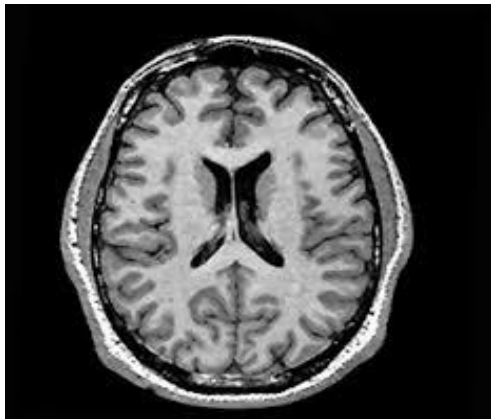
- 1- Input image
- 2- Create texture image use entropy filter .

The function entropy filter returns an array where each output pixel contains the entropy value of the 9×9 neighbor-hood around the corresponding pixel in the input image I.

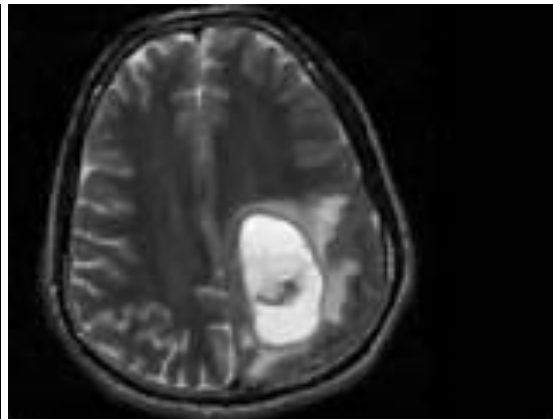
- 3- Create rough mask for the texture.
- 4- Create result of texture morphology as shown in Fig. (1-3) comparing

between normal MRI human and patient MRI human in texture method.

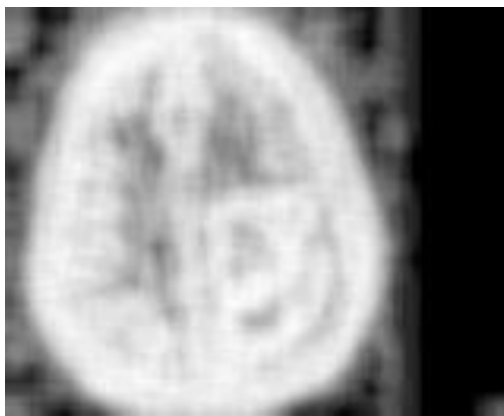
The result of texture morphology as shown in Figure (1-3) comparing between normal MRI brain and abnormal MRI brain in texture method.



a- original image of normal MRI brain

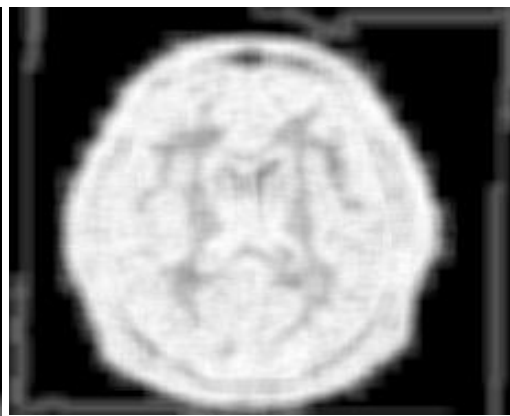


b- original image of abnormal MRI brain



c- texture image of normal MRI brain

use of rough mask



d- texture image of abnormal MRI brain

use of rough mask



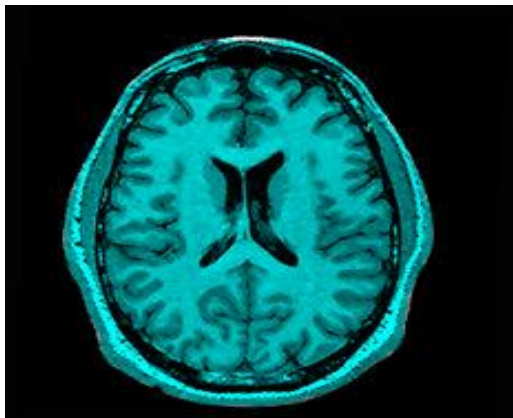
e- the segment onject in the binary image
of normal MRI brain



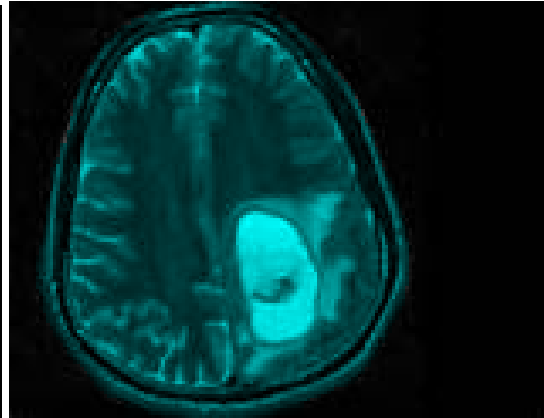
f- the segment onject in the binary
image of abnormal MRI brain



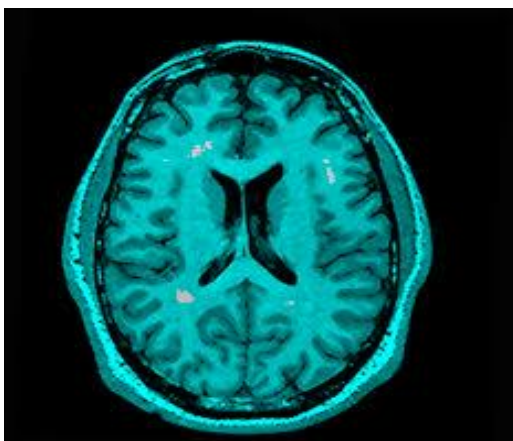
g- smoothing edges of normal MRI brain



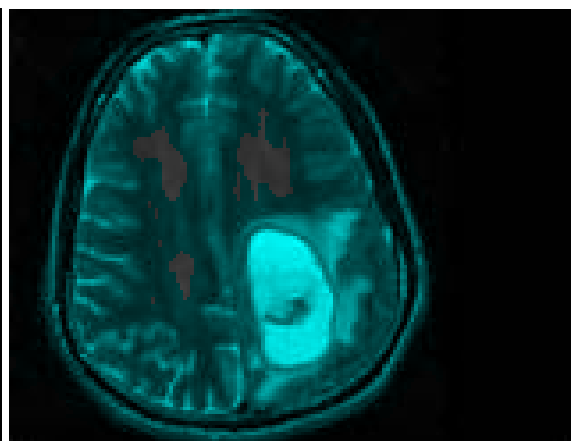
h- smoothing edges of abjnormal MRI brain



i- Raw image of the top texture
of normal blood

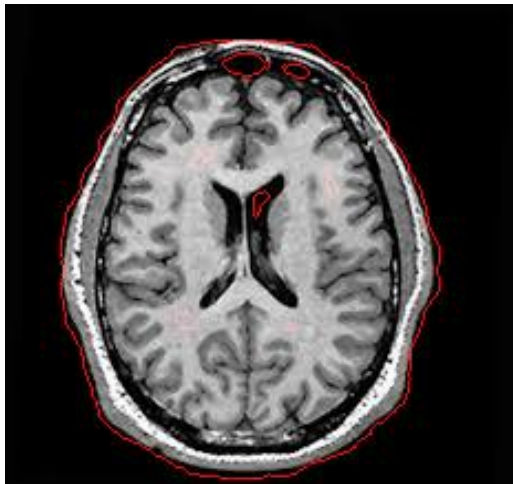


j- Raw image of the top texture
of abnormal blood

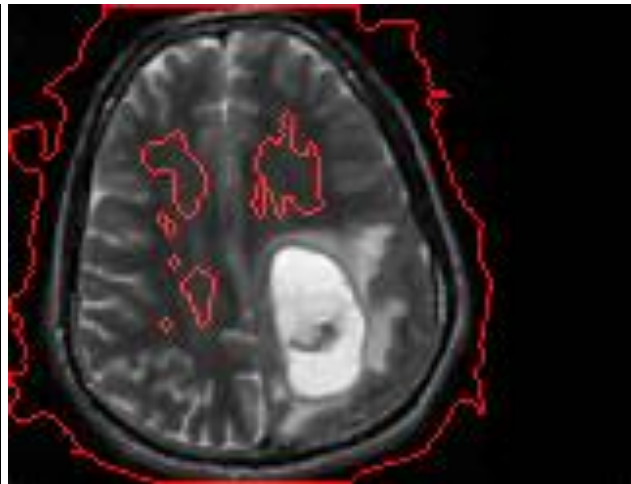


k- extract the top and bottom texture
use the mask2 of normal MRI brain

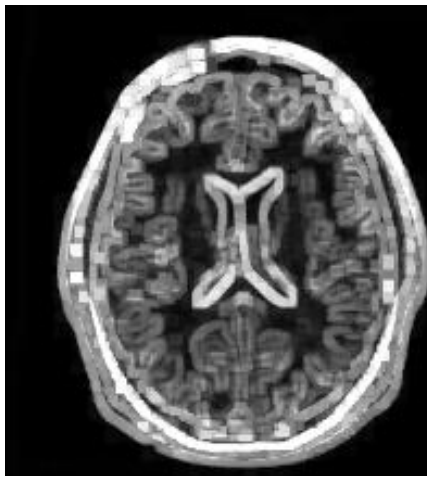
l- extract the top and bottom texture
use the mask2 of abnormal MRI brain



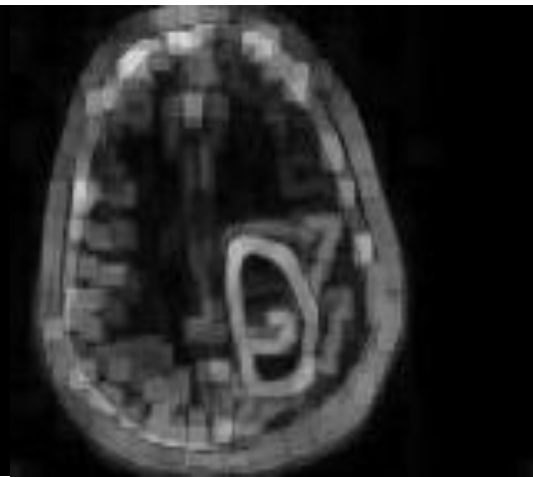
m- boundary between two textures
of normal MRI brain



n- boundary between two textures of
abnormal MRI brain



o- segmentation by range filter
of normal MRI brain



p- segmentation by range filter
of abnormal MRI brain

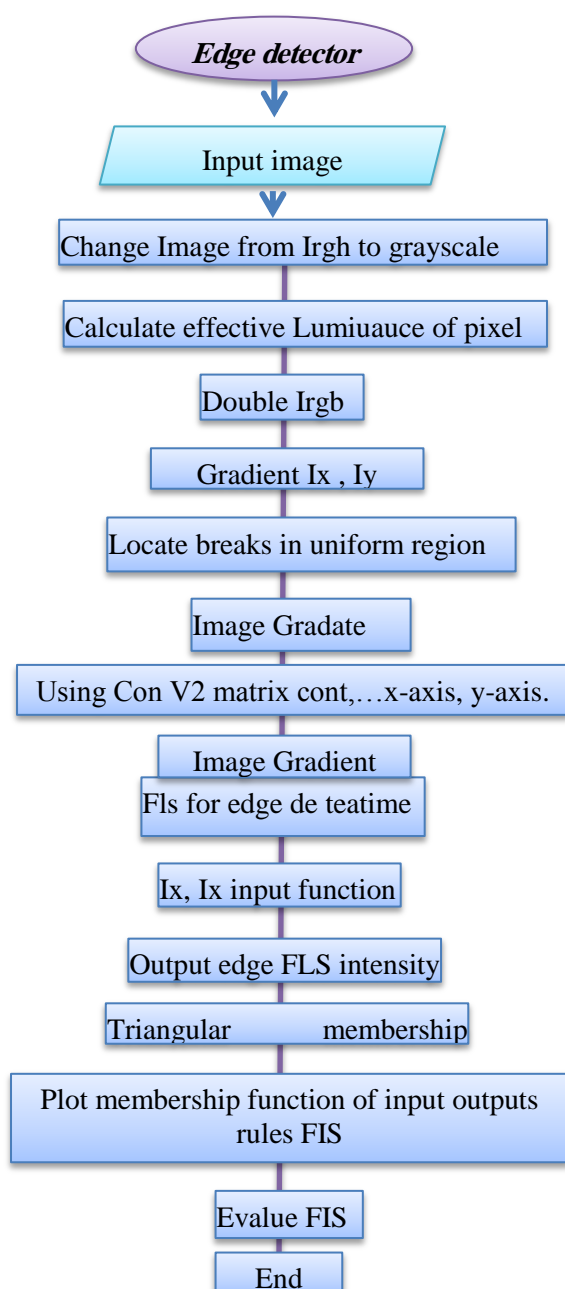
Fig. (1-3- a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p): The result of texture comparing between normal MRI brain and abnormalMRI brain in texture method.(a- original image of normal MRI brain, b- original image of abnormal MRI brain, c- texture image of normal MRI brain use of rough mask, d- texture image of abnormal MRI brain, e- the segment onject in the binary image of normal MRI brain use of rough mask, f- the segment onject in the binary image of abnormal MRI brain, g- smoothing edges of normal MRI brain, h- smoothing edges of abnormal MRI brain, i- Raw image of the top texture of normal blood, j- Raw image of the top texture of abnormal blood, k- extract the top and bottom texture use the mask2 of normal MRI brain, l- extract the top and bottom texture use the mask2 of abnormal MRI brain, m- boundary between two textures of normal MRI brain, n- boundary between two textures of abnormal MRI brain, o- segmentation by range filter of normal MRI brain, p- segmentation by range filter of abnormal MRI brain)

6. Conclusions

Computer code has been adopted for analysis of MR Images (normal and diseased) which is texture of images. The texture images techniques can give better results in the bulk of the blood and MR Images due to implementing three types of filters, (Entropy, Standard Deviation STD and Range).

Appendix A

Edge detector Code



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