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Classification of brain lesion using watershed segmentation and law's mask texture measurment

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The ability to perform accurate diagnosis with all types of stroke and cancer is very important, and with the availability of digital image this information, helps in medical treatments. However, no delay in treatment or error in diagnosis. Currently, there is a lot of research on the development of many methods with the application of MRI to diagnose brain injuries. However, in this paper, a CT image is used to diagnose brain lesion. The mask code is used to extract the texture feature from the CT image. Although there is no strict definition of the force of the image, it can easily be seen by humans and is believed to be a rich source of visual information about the nature of the physical shapes. The watershed classification process is used here to separate the lesion part from the other part of the image, the textural analysis which is called the law`s matrix energy with a modified matrix is convolved with the selected image to obtain the textural features.

Keywords: Brain stroke, brain cancer, watershed segmentation, Law's Mask Texture

INTRODUCTION

For the inability to capture images, analyze and define patterns, slide segmentation plays a very large role. The most important role of the division process in separating an image into areas with one or more properties such as color and texture and gray level, the results of the division are mainly for better analysis and meaningful images. Several approaches are introduced in the field of fragmentation (Beucher,et al., 1993,Chen et al., 2003) among which a well-known method is the watershed algorithm (Wirth et al, 2003,Grau et al., 2004,Rajab et al., 2004). It can use this algorithm in different areas of life to divide images where trying to divide medical images. Detection of the edge of medical images is an important work to identify the human organs such as the brain, heart, kidneys, etc. It is also an essential step for initial processing in medical image fragmentation. [6,7] Medical images such as CT and X-ray imaging produce various information about internal organs that are very important for diagnosing doctors In general, the textures of medical images are complex visual patterns consisting of entities, or sub forms, with distinct brightness, color, gradient, size, and so on. The fabric can be seen as a match in the image (Rosenfeld 1982). The watershed algorithm is an important mathematical morphological method .It has been adopted depending on the region or area of treatment. Watershed technology is the most widely used in many areas of image processing, including medical images (Tang et al., 2000, Beucher, 1994). Texture Matrix Energy Measures presented the statistical feature for the texture with the threshold value for each image; the mean value presented the intensity of the image, and the high value means the image is bright if it is low means that the image is dark. The entropy gives indication about the number of gray level value in the image (Mazhir et al, 2017). It gives information about the randomness of the distribution of gray level pixel. When the entropy is high, the number of gray level is high. The energy is inversely proportional to the entropy it decreases as the number of gray level in the image increases (Ali et al., 2018).

MATERIALS AND METHODS

The work includes some operations that started by resizing the collected images to 512 x 512 and converting them into gray images three CT images are used for each case in which (9) CT images is the study samples. A binary mask is created to remove the external skull from the brain tissue to avoid confusion in detecting the brain stroke and cancer , the traditional isolation method is the threshold is used as a first step trying to separate the tumor from the rest of the images each image has a threshold depends on the type of tumor. The watershed segmentation involves a series of processes has been used as a classification technique, finding a gradient that is the edge of the tumor, an open and closing process, isolating the tumor area and turning the watershed. The median filter is used as an optimization method to remove unwanted information, which may be considered noise at the size of 7 x 7 window, then calculated the Law mask energy matrix which is a five one dimension matrix convolved with each other to produce a two dimension matrix, then a new modified matrix is obtained, this matrix will convolved with the select images to calculate the textural features. The law mask textural features are the energy, entropy and mean square.

Watershed Segmentation

Watershed segmentation is a gradient-based fragmentation technology. The gradient map of the image is considered as a relief map. It cuts the image as a lash. Divided areas are called assembly basins. Segmentation of water partition solves a variety of image fragmentation. It is suitable for photos that have higher density value. To control fragmentation, a watershed controlled by a marker. Sobel is suitable for edge detection, the open and close is also important in completing the watershed segmentation (Jobin et al, 2001).

Opening and Closing :

In general the opening process deals with the edges of the object; it makes them smoother by eliminating the thin edges. It is erosion followed by dilation, the closing process also deals with the edges of the object, they merge the narrow lines and break the thin lines, and they eliminate small gabs, and fill the holes in the contour. Closing is dilation followed by erosion (Mazhir et al, 2016). Dilation expands the components of an image and erosion shrinks them. Gray scale closing is accomplished by first performing gray scale dilation with a gray scale structuring element, then gray scale erosion with the same structuring element. The close and open operation introduced for binary images can easily be extended to gray-scale images. In the same way, gray scale opening is realized by gray scale erosion followed by gray scale dilation (Rafael, 2008, Ali 2017). Figure(1,2,3,4,5,6,7,8,9) shows the watershed segmentation, the stroke and cancer isolation.

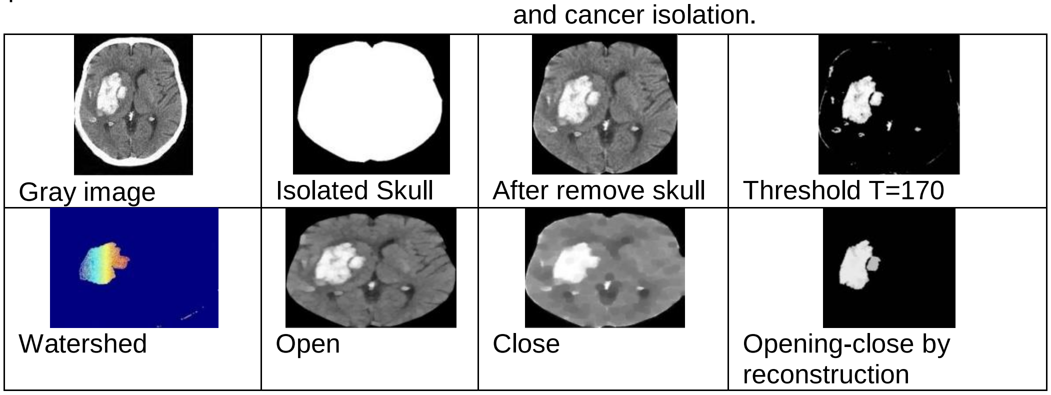


Figure (1) image No.1 the watershed segmentation (Hemorrhage stroke).

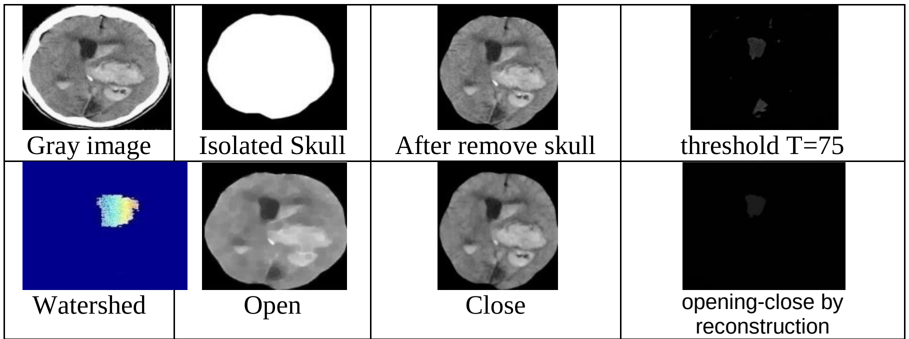


Figure (2)shows image No.2 the watershed segmentation (Hemorrhage stroke).

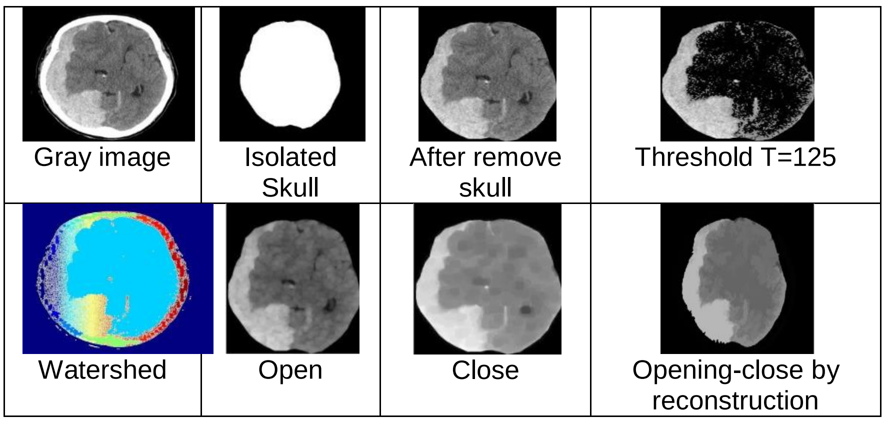


Figure (3) shows image No.3 the watershed segmentation (Hemorrhage stroke)

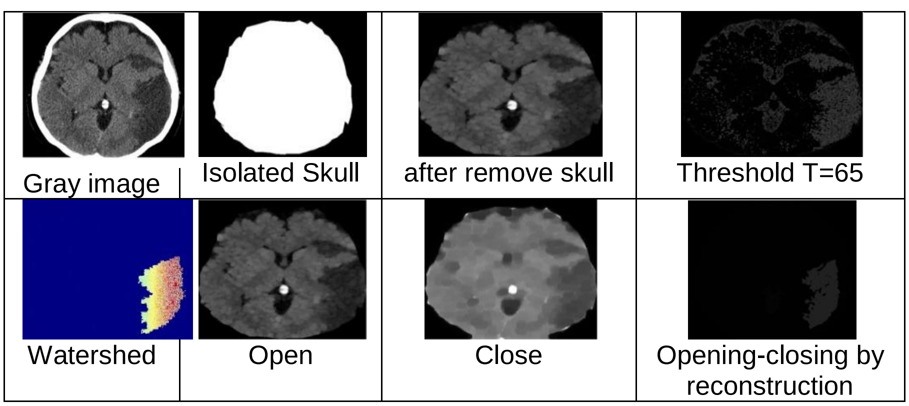


Figure (4)shows image No.4 the watershed segmentation ((Ischemic stroke)

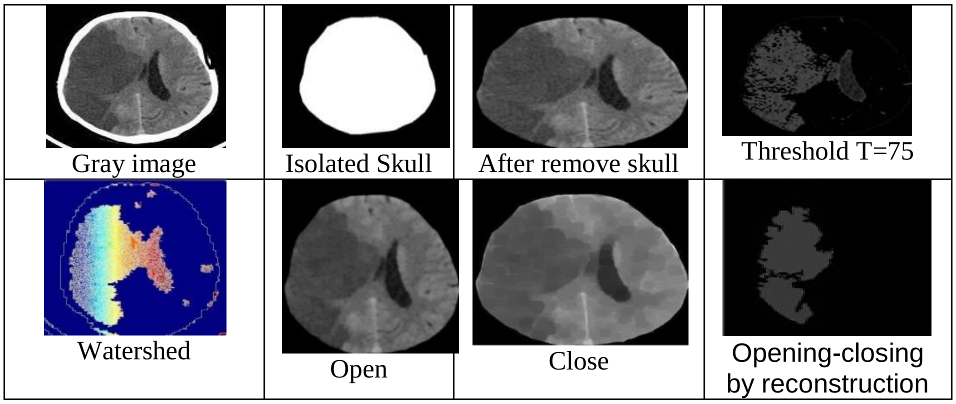


Figure (6)shows image No.6 the watershed segmentation ((Ischemic stroke)

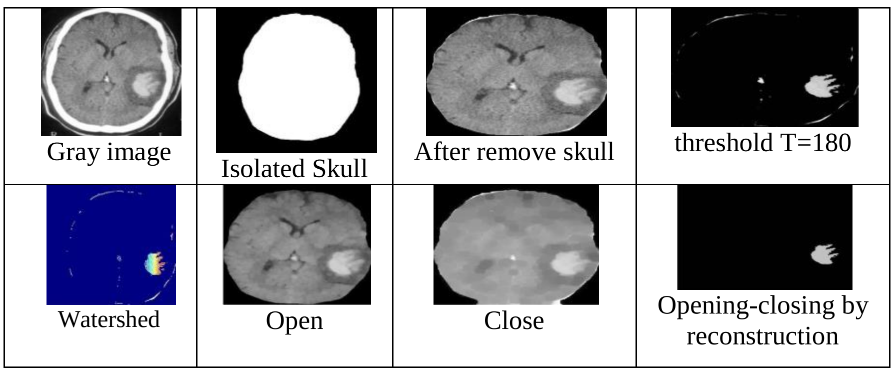
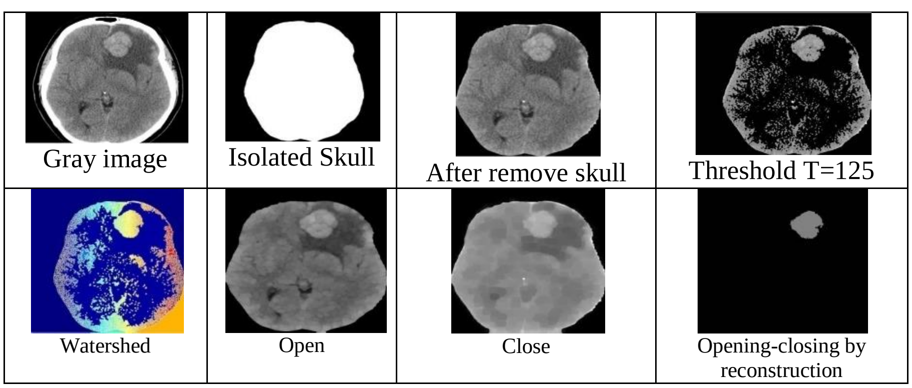
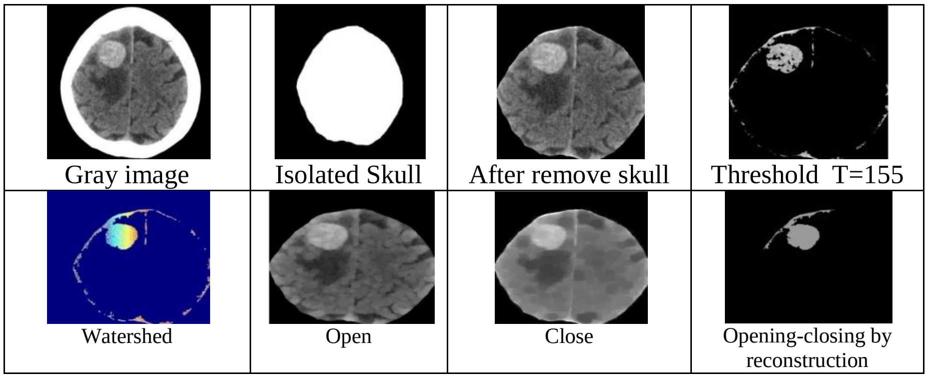


Figure (7)shows image No.7 the watershed segmentation (Cancer case).



Figure(8) shows image No.8 the watershed segmentation (Cancer case)



Figure(9) shows image No.9 the watershed segmentation (Cancer case).

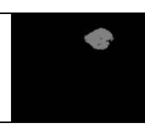
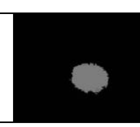
Table (1) the statistical features of law's mask for hemorrhage stroke case.

Region of interest			
Entropy	2.3738 e-1	1.8354 e-1	1.8354 e-1
Mean-square	9.8908 e-1	9.8908 e-1	9.8908 e-1
Energy	2.5645 e-2	2.5645 e-2	2.5645 e-2

Table (2) the statistical features of law's mask for ischemic stroke case.

Region of interest			
Entropy	2.2348 e-1	5.4905 e-1	6.8765 e-1
Mean-square	1.0880 e-1	2.8683 e-1	3.6596 e-1
Energy	3.1030 e-2	2.1567 e-2	3.5108 e-2

Table (3) the statistical features of law's mask for cancer case.

Region of interest			
Entropy	2.3738 e-1	4.0369 e-1	2.3738 e-1
Mean-square	9.8908 e-1	2.5221 e-1	9.8908 e-1
Energy	2.5645 e-2	1.6676 e-2	2.5645 e-2

Law's Mask Texture Energy Measures :

Useful for estimating the repetition of image elements, such as ripples, edges, or spots.Proposed laws to convert images using linear filters. During conversion, each pixel of the image is set to a value that is a set of initial gray levels for pixels that belong to any of the converted pixels. Two types of neighborhoods are usually considered: 3 x 3 pixels and 5 x 5 pixels. The weights of the adjacent pixels are determined by the zigzag matrix (the so-called mask of laws). For each pair of asymmetric masks, the resulting images can be added. In this case, the images obtained with the application of identical masks are multiplied by two. On the basis of a converted image, entropy, energy and mean- square can be calculated. Also, filtered images can be exposed again for further transformation, resulting in the creation of texture energy images. Finally (Selvarajahet al, 2013).

The laws set out five rated vectors that could be combined to form two-torsion beads. When combined with a tight image, these masks extract individual structural components of the image(Elnemr, 2013).

The five vectors are:

L5 = [1, 4, 6, 4, 1]   E5 = [-1,-2, 0, 2, 1],
S5 = [-1, 0, 2, 0,-1   R5 = [1,-4, 6,-4, 1
W5 = [-1, 2, 0,-2, 1]

Later, calculating three statistics features; ABSM, mean square or power (MS) and entropy as follows:

ABSM= $\frac{1}{MN}\sum_{x=1}^{M}\sum_{y=1}^{N}|f(x.y)| \dots\dots\dots\dots\dots (1)$

MS= $\frac{1}{MN}\sum_{x=1}^{M}\sum_{y=1}^{N}f^2(x.y) \dots\dots\dots\dots\dots\dots (2)$

Entropy=

$$\frac{1}{MN}\sum_{x=1}^{M}\sum_{y=1}^{N}f(x.y)(-\log_2 f(x.y)) \dots (3)$$

The reciprocal multipliers of these vectors, taking into account the first term as a column vector and the second term as a row vector, After convolving these five vectors with each other and with each one, produce (5 × 5) matrix known as masks of law`s (Vojnovicet al, 2013).

By combining Law's Mask with image texture and calculating energy statistics, a vector of features is derived that can be used to describe the texture.

Where f (x, y) is the pixel value, and M and N are the dimensions of the image (Elnemr HA, 2013).

RESULTS AND DISCUSSION:

Table (4) and figure (10) represent the average value for the statistical features for the Stroke and cancer case. The result shows that the stroke (hemorrhage and ischemic) have the same value of energy and it is higher than the cancer, also the mean-square value is the same for both hemorrhage and ischemic. The entropy curve shows the ischemic has the highest value than the cancer and the hemorrhage; the lowest value is for the cancer.

Table (4) shows the average value for the statistical features for the Stroke and cancer case.

Infection	Entropy	Mean-square	Energy
Cancer	0.292817	0.743457	0.022655
Ischemic	0.486727	0.253863	0.029235
Hemorrhage	0.201487	0.253863	0.029235

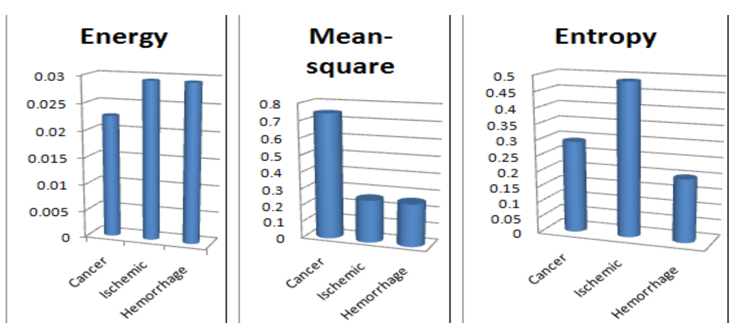


Figure (10) Shows the curve for average value of the statistical features for Law's matrix for stroke and cancer.

CONCLUSION

The stroke can be define as the block of the blood vessel or the bleeding occur in the blood vessel the hemorrhage stroke, the blood leaks into the brain tissue, so it entropy is lower than the ischemic and the cancer, the energy of the Hemorrhage and ischemic are the same because the stroke is either block or bleeding in the brain vessel it is not a strange tissue, while the cancer is a forgone texture in the brain tissue so its energy is lower than the stroke. The mean square for the Hemorrhage and ischemic is the same while for the cancer is higher than for the stroke

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest

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AUTHOR CONTRIBUTIONS

AHA suggested the point of research and designed the experimental work plan and participated in field application. AHA and SAA and MR and ANM participated in field work and data collection and analysis of the data. All authors read and approved the final version.

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