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Detection of Abnormalities in MRI Images using Texture Analysis*

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Abstract: Medical imaging technique most commonly is used in to visualize the internal structure and function of the body. It is a image processing based method and this method may not provide complete diagnosis through the scanned images or their machines as performed by the medical agents. So, this method can even detect the smallest abnormality even in the earliest stage which the scan may or may not detect. Textures features of MR image segmentation have been provided. The analyses of both the normal and abnormal images are done. The ranges of both the types of images are calculated and then the comparison is performed between them. So, to determine the whether the abnormality is there or not in the image, its texture features are compared and the feature lying outside the range finally detects the abnormality in the biomedical image. In this paper different MR scans of patients are taken having abnormality in their brain. Five cases are observed, on the bases of their comparison, the result is obtained at the end indicating the whether the presence of abnormality in the image.

1. Introduction

It is the process of algorithmically constructing a large digital image from a small digital sample image by taking advantage of its structural content. It is object of research to computer graphics and is used in many fields, amongst others digital image editing, 3D computer graphics and post-production of films. Texture is an ambiguous word and in the context of texture synthesis may have one of the following meanings:

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1. In common speech, *texture* used as a synonym for *surface structure*, which is described by five different properties in the psychology of perception: coarseness, contrast, directionality, line-likenessand roughness.
2. In 3D computer graphics, a texture is a digital image applied to the surface of a three-dimensional model by texture mapping to give the model a more realistic appearance. Often, the image is a photograph of a *real* texture, such as wood grain.
3. In image processing, every digital image composed of repeated elements is called a texture.

2. Flowchart for the Determination of the Abnormalities in Biomedical Image Using Texture Segmentation

The detection of defects in biomedical images using texture segmentation is shown in the flowchart given below:

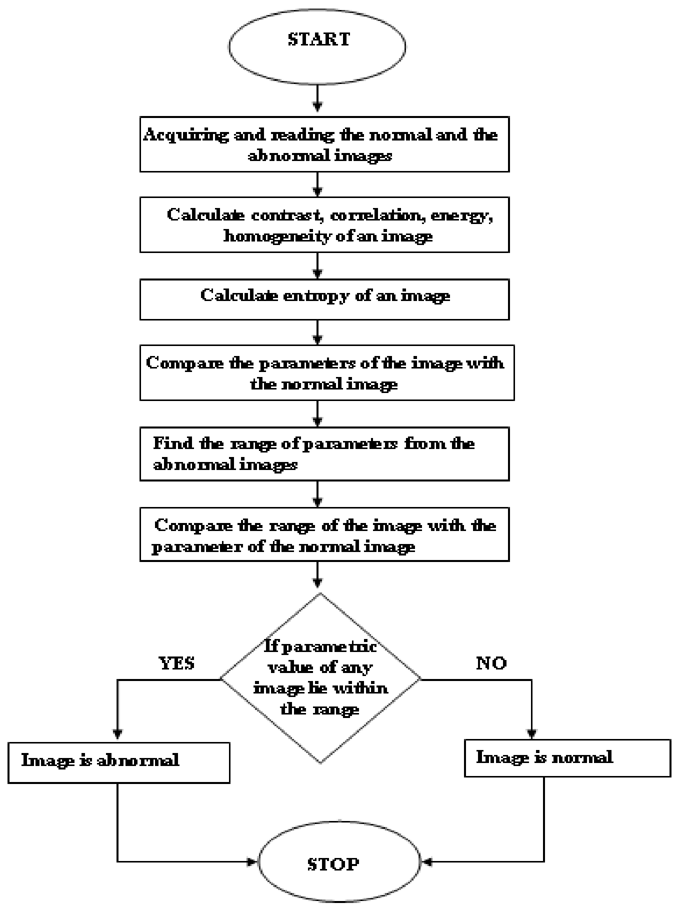


Image 1: Flowchart for the determination of normal and abnormality image

3. Algorithm for the Determination of the Abnormalities in Biomedical Image Using Texture Segmentation

STEP 1: Firstly the normal and abnormal images are read

(3.1) A = imread(filename,fmt)

STEP 2: Calculate the contrast, correlation, homogeneity and energy of the abnormal images.

(3.2) stats = graycoprops(glcm, properties)

STEP 3: Calculate the entropy of the abnormal images using entropy function of matlab

(3.3) E = entropy (I),

(3.4) $-\sum_{i}^{m}\sum_{j}^{n} p[i,j] \log P[i,j]$.

STEP 4: Now, find the parameters of the normal image using graycoprops and entropy function are the inbuilt functions of the matlab.

STEP 5: Find the range of the parameters of the abnormal images.

STEP 6: Compare the parameter of the normal image and the parameters of the abnormal images. It will be observed that the normal image parameters do not lie within the range.

STEP 7: Finally, a conclusion is obtained that the image parameters lying within the range is the abnormal image and consists of tumor.

(a) Contrast: Returns a measure of the intensity contrast between a pixel and its neighbor over the whole image.

(3.5) $\sum_{i,j} \left| i \quad j \right|^{2}$ p(i,j).

(b) Correlation: Returns a measure of how correlated a pixel is to its neighbor over the whole image.Range = [-1 1]. Correlation is 1 or -1

(3.6) $\sum_{i,j} \frac{(i-\mu i)(j-\mu j)(p(i,j))}{\sigma_i \sigma_j}$.

(c) Energy: Returns the sum of squared elements in the GLCM.
Range = [0 1]

$$\sum_{i,j} p\left(i,j\right)^2 . \tag{3.7}$$

(d) Homogeneity: Returns a value that measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal.
Range = [0 1]

$$\sum_{i,j} \frac{p(i,j)}{1+\left|i-j\right|} . \tag{3.8}$$

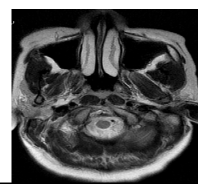
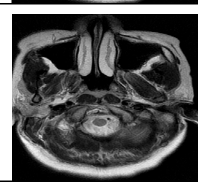
Image Type	Image
Normal Image I	
Abnormal Image II	
Abnormal Image III	
Abnormal Image IV	
Abnormal Image V	
Abnormal Image VI	

Image 2: MRI of patients

4. Tabular Formation of the Textures Features of Normal and Abnormal Images

Textural feature	Mean	Max.	Min.	Normal
Contrast	2.0003	2.1638	1.8478	2.2723
Correlation	0.0211	0.0029	0.0481	0.052
Energy	1.6114	1.6949	1.5784	1.559
Homogeneity	0.0277	0.0287	0.0268	0.0249
Entropy	6.8707	6.958	6.7175	6.6597

Range for determining the abnormality

Image Type	Contrast	Correlation	Energy	Homogeneity	Entropy
Image I	2.2723	0.052	1.559	0.0249	6.6597
Image II	2.1638	0.0034	1.5784	0.0277	6.958
Image III	2.0134	0.0035	1.6239	0.0268	6.8663
Image IV	2.084	0.0029	1.6241	0.0271	6.7876
Image V	1.8478	0.0489	1.6949	0.0284	6.7175
Image VI	1.8928	0.047	1.5644	0.0287	7.0244

5. Graphical Representation of the Parameters of the Normal and Abnormal

The representation of the parameters graphically indicates visually the ranges that were tabularly obtained and makes the study more clear. This way the difference between the normal and abnormal image is obtained and can indicate whether the patient's report is positive and contains tumor or any abnormality.

1. **Contrast:** The contrast of the normal image is having the maximum value i.e. 2.2732 and is not within the range of the abnormal images.

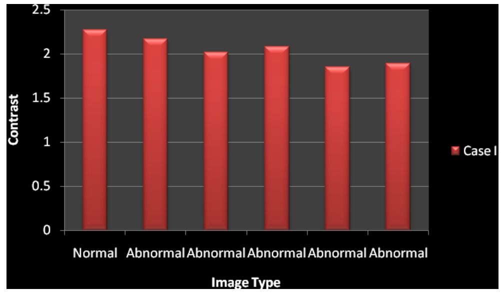


Image 3: Comparison between the contrast of normal and abnormal image

2. **Correlation:** The correlation of the normal image is having the maximum value i.e. 0.0052 and is not within the range of the abnormal images.

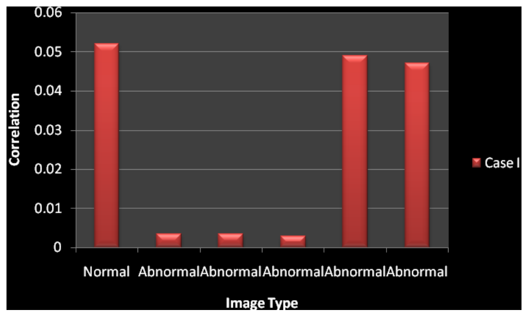


Image 4: Comparison between the correlation of normal and abnormal image

3. **Energy:** The energy of the normal image is having the least value i.e. 1.559 and is not within the range of the abnormal images.

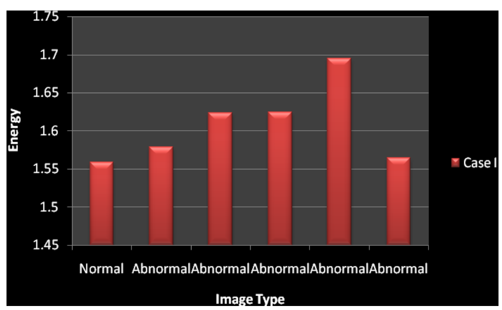


Image 5: Comparison between the energy of normal and abnormal image

4. **Homogeneity:** The homogeneity of the normal image is having the minimum value i.e. 0.0249 and is not within the range of the abnormal images.

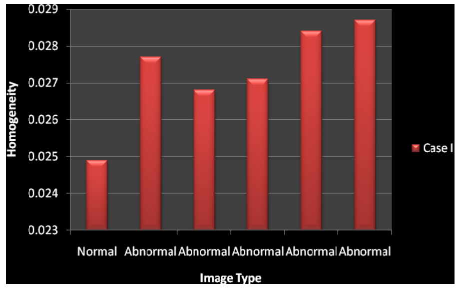


Image 6: Comparison between the homogeneity of normal and abnormal image

5. **Entropy:** The entropy of the normal image is having the least value i.e. 6.6597 and is not within the range of the abnormal images.

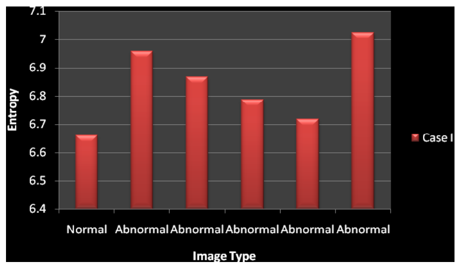


Image 7: Comparison between the entropy of normal and abnormal image

6. Conclusion

This paper provides the segmenting textures features of MR images. The texture analyses of both the normal and abnormal images are done. On the bases of the values of abnormal images, the range is calculated and further the texture features of normal image are compared. So, to determine the whether the abnormality is there or not in the image, its texture features are compared and the feature lying outside the range finally concludes that image is normal.

It is seen that 5 different cases are taken and each case consists of 5 abnormal image and 1 normal image of a particular part of the brain. Texture analysis of the 5 different images of each case is done by finding their contrast, correlation, energy, homogeneity and entropy, and then their range is obtained. Finally, analysis of the normal image of each case is performed. The texture value of particular normal is compared with the range of that particular case. If the value outside the range concludes the normality of the image.

7. Future Scope

In this paper texture analysis of medical images is performed which subscribed of lesser number of images which may not prove a much accurate result. So, in order to get a better accuracy, large amount of images must be taken. The images that here observed are the MR images of the brain of the patients. Different body parts images can also be taken and their analysis can be done. Different scan images can also be taken and their texture analysis can be performed.

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