An Implementation Of Statistical Feature Algorithms For The Detection Of Brain Tumor

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Abstract

A member of a population who is at risk of becoming infected by disease is a susceptible individual. Finding disease susceptibility and generating an alert in advance, is valuable for an individual. The aim of the work presented a feature vector using different statistical texture analyses of brain tumors from an MRI image. The statistical feature texture is computed using GLCM (Gray Level Co-occurrence Matrices) of brain tumor cell structure. For this paper, the brain tumor cell segmented using the strip method to implement hybrid Assured Convergence Particle Swarm Optimization (ACPSO) - Fuzzy C-means clustering (FCM). Furthermore, the four angles 0o, 45o, 90o, and 135o have calculated the segmented brain image in GLCM. The four angular directions are calculated using texture features are correlation, energy, contrast and homogeneity. The texture analysis is performed on different types of images using past years. So, the algorithm proposed statistical texture features are calculated for iterative image segmentation. The algorithm FETC (Feature Extraction Tumor Cell) extracts statistical features of GLCM. These results show that MRI images can be implemented in a system of brain cancer detection.

Keywords: PSO; ACPSO; GLCM; FCM

1. Introduction

Texture can be categorized in four classes, e.g. transforms based, model based, structural based and statistical based texture analysis. In model-based analysis, experiential model of pixel intensities and its neighbors is generated and then analyzed. In transform-based texture analysis, the analysis is performed after representing the image in its frequency domain. Analysis of structural features includes pixel, lines and specific shape which could be stored as templates. This analysis can be divided in two types, e.g. first order statistical features and second order statistical features [5]. As explained in literature review, structural and statistical features have found to be successful for detection of tumor cell. Thus, in the present research work statistical texture features are used to generate feature vector to locate tumor cell condition from the input image. In this regard, detailed explanation about statistical texture features is given in the following section.

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1.1 First Order Statistical Features

Histogram-based features viz. kurtosis, skewness variance, mean, and are called as first order statistical features. The mean value gives an average of gray levels [4] of the selected region. It is useful to find the average intensity of the selected region. It doesn't give any information about texture. The variance gives the value of gray level variations from the mean value of gray level. The Skewness gives the value of the asymmetry of the gray levels found around their mean value. Negative skewness indicates an inclination of data spread towards the left of the mean and positive skewness indicates an inclination of facts spread towards the right of the mean. Kurtosis gives the shape of the tail of the [12] histogram i.e. it tells how a distribution is outlier-prone. First order statistical features give information about pixel intensities for complete image and they do not carry information concerned with the relative location of the pixel region with respect to each other. Thus, in this research work first order statistical features are not considered.

1.2 Second Order Statistical Features

As the histogram gives a count of intensities present in the image, variations in pattern relative to position of pixel represent a texture in the image. [8] It does not give any data about comparative location of pixels with respect to each other. Trials of texture computed by means of histograms suffer from the constraint that they carry no data regarding the relative location of the pixel region with respect to each other. Thus, along with distribution of pixel intensity, relative location of pixel is also important for analysis of texture feature. One such type of feature extraction is carried out from GLCM.

1.3 Gray Level Co-occurrence Matrix (GLCM)

A GLCM gives the probability distribution of texture present in an image at a given offset. If an image of size (m x n) contains an N number of gray shades or levels, then the size of GLCM is (N x N). The offset, (D_x, D_y) represents the displacement among the pixel of interest and its neighbor in x and y directions by distances D_x and D_y. Figure 1.1 explains the concept of the offset. For example, for offset (1, 0), co-occurrence of pixel intensity i at pixel (x, y) with pixel intensity j at pixel (x+1, y+0) is counted as 1 and added to GLCM matrix at location (i, j). Displacement can also be represented by an angle, where displacement (1, 0) indicates statistical information of texture at 00. The relation between displacement and angle is given in Table 1

Table 1. The relation between displacement and angle

OFFSET	ANGLE
[0,1]	0^0
[-1, 1]	45^0
[-1, 0]	90^0
[-1, -1]	135^0

2. Proposed Method

The sample images analysed texture feature correlation, energy, contrast and homogeneity.

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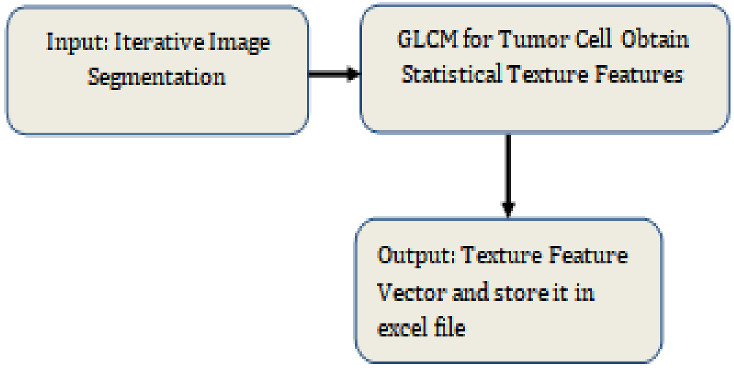

Figure 1. Block Diagram of FETC Algorithm

2.1 Input to FETC Algorithm

The algorithm FETC extracts statistical features of GLCM. Input to the algorithm is segmented brain tumor cell obtained as explained in section 6. Figure 1. shows input image and str4 of the automatically segmented brain tumor cell using the strip method.

2.2 Generation of GLCM for Tumor Cell

The algorithm extracts various GLCM statistical measurements at different angles like 0^0, 45^0, 90^0 and 135^0. From every angle, Gray values measured have pixel intensity values as 256 and 128. Four texture measures considered are Contrast, Correlation, Energy and Homogeneity (CCEH) [11].

2.3 FETC Algorithm

- Input: Segmented tumor cell using brain MRI image
- Output: GLCM statistical features at four angles viz. 0^0, 45^0, 90^0 and 135^0
- Set offset0 as [0, 1] representing 0^0
- Set offset45 [-1, 1] representing 45^0
- Set offset90 [-1, 0] representing 90^0
- Set offset135 [-1, -1] representing 135^0
- Set Number of gray levels = 256

The following steps are performed on the input image:

i. Input segmented brain tumor cell from the input image.
ii. Open excel file.
iii. Perform steps a to d, mentioned below to find GLCM statistical features, for all the images.
   a. Set Distance between the pixel of attention and its neighbor D = 1
   b. Generate GLCM matrix for offset0 and Gray levels = 256
   c. Generate four GLCM features viz. Contrast, correlation, energy and homogeneity Store features in excel file.
iv. Repeat steps from iii and iv for offset 45, offset 90, offset 135.
v. Perform steps e to g mentioned below to calculate structural features.
   a. Generate Watershed Transform of giving input and count number of connected components.
   b. Generate Radom Transform and calculate the number of lines at various angles viz. 0^0, 45^0, 90^0 and135^0.
   c. Store structural features in the file

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3. Experimental Result and Analysis

Four statistical GLCM features extracted from a digital brain tumor image are CCEH. They are extracted at various angles as mentioned above. 10 images were selected for feature extraction. Features extracted at various angles from these images are stored in Excel sheet. Table 8.8 shows the mean values of GLCM features at str2. It can be observed that GLCM features are similar for str2 for all the angles. GLCM features with two different intensities 256 and 128 are shown in this table. A row with intensity 256 indicates that GLCM is generated with maximum intensity 256. I.e. dimensions of this GLCM are (256 x 256). A row with intensity 128 indicates that GLCM is generated with maximum intensity 128. I.e. dimensions of this GLCM are (128**x** 128). It can be observed that values of four texture features at different angles are almost similar with intensity 128 and 256. Thus, in this research work 256 intensities are considered for generating features.

Table 2: Average of Strip str2 in GLCM Texture Feature

Angular of Image Intensity	**Offset**		**Contrast**	**Correlation**	**Energy**	**Homogeneity**
128, 0º	0	1	61.2	0.96	0.019	0.9
128, 45º	-1	1	138	0.9	0.017	0.62
128, 90º	-1	0	95.1	0.94	0.015	0.73
128, 135º	-1	-1	94.3	0.94	0.014	0.68
256, 0º	0	1	289	0.96	0.019	0.78
256, 45º	-1	1	569	0.9	0.017	0.54
256, 90º	-1	0	379	0.94	0.015	0.68
256, 135º	-1	-1	374	0.94	0.014	0.63

The energy also measures high value in the vertical direction. The energy value is higher in the angle of 0º compared other angles. When the image intensity is reduced from 256 to 128, the contrast value also reduced. But the value of energy, correlation and homogeneity have not changed even if the image intensity count is reduced.

4. Conclusion

The spectrum of methods followed the designs of feature vector for brain nodule using statistical texture analysis. This paper mainly focused on statistical texture analysis using in brain cancer image using GLCM matrix. The Feature Analysis measure four texture features are energy, contrast, correlation and homogeneity with two image intensity 128 and 256. The image intensity is used to calculate four directions like 0º, 45º, 90º and 135º using GLCM features. It performs the minimum and maximum value of the different angle. In future, the statistical texture feature is very useful to analyze the structure of the image features.

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