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Classification of Brain Tumor Using Texture Analysis

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Abstract: ***Diagnosis of brain tumor is very critical ordinarily, this study presents a highly efficient method to identify, diagnosis and classify the intracranial tumors. Forty-nine CT images contain different types of intracranial tumor were selected, the procedure contain dual phase, phase one contain feature extraction from the selected images, phase two classification of images component according to the extracted features using linear discriminant analysis, the quantitative results showed that the proposed method has high accuracy in recognizing the intracranial tumor from the normal surrounding tissues. The accuracy of classification was 90.4%.***

Keywords: classification, texture feature, linear discriminant analysis, computed tomography CT, brain tumor

1. Introduction

A brain tumor is a group of abnormal cells that grows in or around the brain. Tumors can directly destroy healthy brain cells. They can also indirectly damage healthy cells by crowding other parts of the brain and causing inflammation, brain swelling and pressure within the skull. Brain tumors are either malignant or benign. A malignant tumor, also called brain cancer, benign brain tumors do not contain cancer cells and are usually slow growing.

Brain tumors fall into two different categories: primary or metastatic. Primary brain tumors begin within the brain. A metastatic tumor is formed when cancer cells located elsewhere in the body break away and travel to the brain.

Brain tumors are classified based on the tumor site, the type of tissue involved, whether it is benign or malignant, and other factors. If a tumor is determined malignant, the tumor cells are examined under a microscope to determine how malignant they are. {1}

By the increasing use of direct digital imaging systems for medical diagnostics, digital image processing becomes more and more important in health care. In addition to originally digital methods, such as Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) {2}

So there are great efforts have been made to improve this field by creating new programs, formulas and methods such as texture analysis.

Texture analysis refers to the branch of imaging science that concerned with the description of characteristic image properties by textural features. However, there is no universally agreed-upon definition of what image texture is and in general different researchers use different definitions depending upon the particular area of application.{3}

The main image processing disciplines in which texture analysis techniques are used are classification, segmentation and synthesis. In image classification the goal is to classify different images or image regions into distinct groups {4}. Texture analysis methods are well suited to this because they provide unique information on the texture, or spatial variation of pixels, of the region where they are applied. In image segmentation problems the aim is to establish boundaries between different image regions {5}

So it is useful methods for discriminating and studying both distinct and subtle textures in multi-modality medical images. Practical implementation requires careful consideration of the power of the individual features to discriminate between textures. This is essential to reduce the influence that heavily correlated features, and features with little discriminatory power, have on the overall classification. Statistical texture analysis techniques are constantly being refined by researchers and the range of applications is increasing. Fractal approaches, which offer the convenience of characterizing a textured region by a single measure, appear more application-specific than statistical approaches and require more research. Algorithmic advances have been made on the use of full 3D texture analysis approaches and the publications in this area demonstrate that this is a promising area of research. This is particularly important given that biomedical image data with near isotropic resolution is becoming more common in clinical environments. However, it has been shown that there is minimal loss of discriminatory power when 2D techniques are applied in the coronal and sagittal planes.{6}

2. Feature Extraction

The transformation of images into its set of features is known as feature extraction. Useful features of the image were extracted from the images for classification purpose. It is a challenging task to extract good feature set for classification. There are many techniques for feature extraction e.g. texture Features, gabor features, feature based on wavelet transform, principal component analysis, minimum noise fraction transform, discriminant analysis, decision boundary feature extraction, non-parametric weighted feature{7}

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For classification and segmentation of brain tumor (qurat-ul-ain etal) used ensemble base classifier after classification tumor regions were extracted from the images which were classified as malignant using two stages segmentation process, segmentation consist of skull removal and tumor extraction phase. Their system had achieved classification accuracy beyond 99%.

A.Padma & R.Sukanesh worked on Automatic Classification and Segmentation of Brain Tumor in CT Images using Optimal Dominant Gray level Run length Texture Features. They applied their method on120 images with normal and abnormal tumor images. They found that for brain tumor classification and segmentation it is best to be performed using support vector machine (SVM) with dominant run length feature extraction method than SVM with wavelet based texture feature extraction method. The authors had attempted to improve the computing efficiency as it selects the most suitable feature extraction method that can used for classification and segmentation of brain tumor in CT images efficiently and accurately. An average accuracy rate was above 97%

3. Methodology

Recent CT images of 49 intracranial tumor were selected for this work all were DICOM images were four regions of interest include neoplastic tissue, normal gray matter, normal white matter and CSF were selected in order to extract the features from each one of them the features included mean, variance, skweness, energy and entropy.

Number of classes was 10 as explained on fig: 3-1

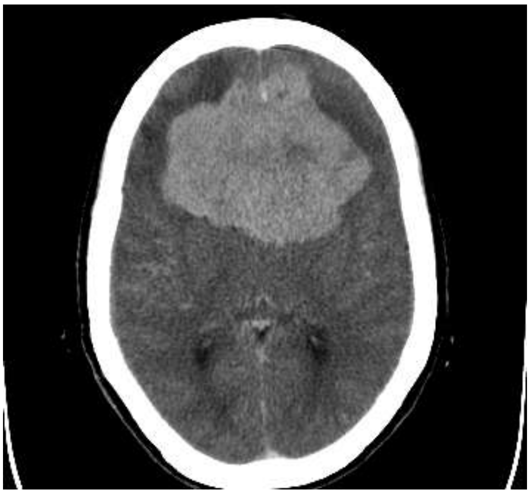

Figure 1: Shows the neoplastic tissue

4. Results and Discussion

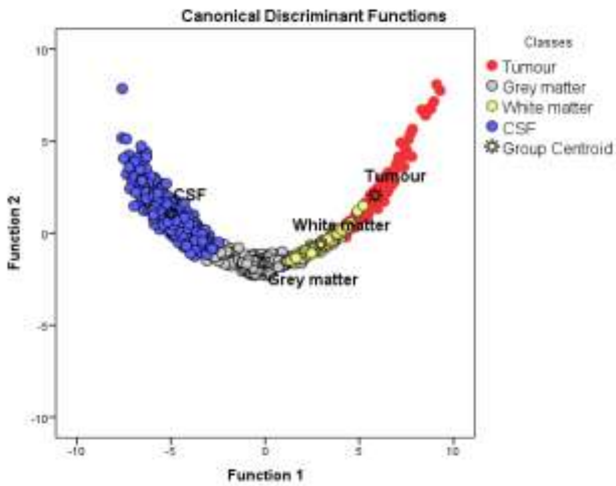

Fig (2) scatter plot shows the classification of the intracranial component texture, which demonstrate that the distances between the classified groups were large while it small between the classes within each group this exploring the ability of the proposed method in recognizing and differentiation between the intracranial component.

		Predicted Group Membership				Total
		Tumor	Grey matter	White matter	CSF	
% Original group	Tumor	**82.6**	0.0	17.4	0.0	100.0
	Grey matter	0.0	**97.6**	2.4	0.0	100.0
	White matter	1.7	.4	**97.9**	0.0	100.0
	CSF	0.0	1.2	0.0	**98.8**	100.0

Table (1) demonstrate groups classification accuracy from which we can figure out there is a little interference between the tumor and white matter,17% of tumor classes recognized as white matter this may due to existence of normal neuronal cells contain character of white matter tissue within the neoplastic area.

There is no tumor class recognized as gray matter or CSF.

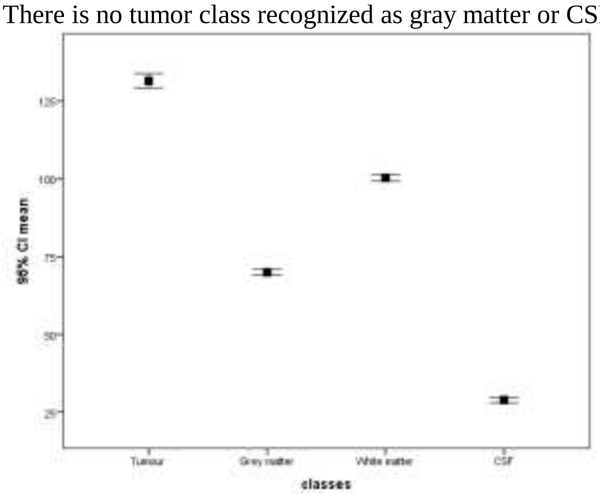

Figure 3: Error bar shows group classification mean based

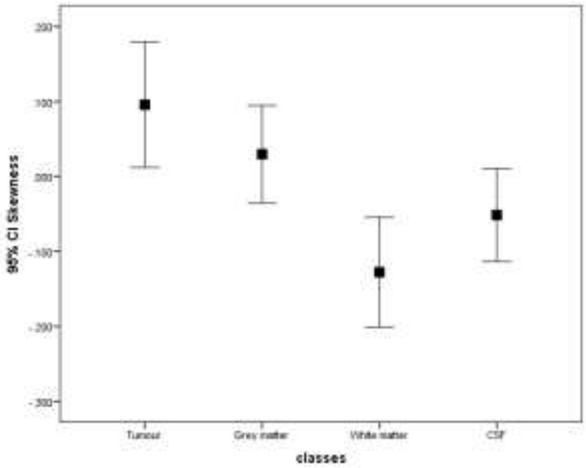

Figure 4: Error bar shows group classification skewness based

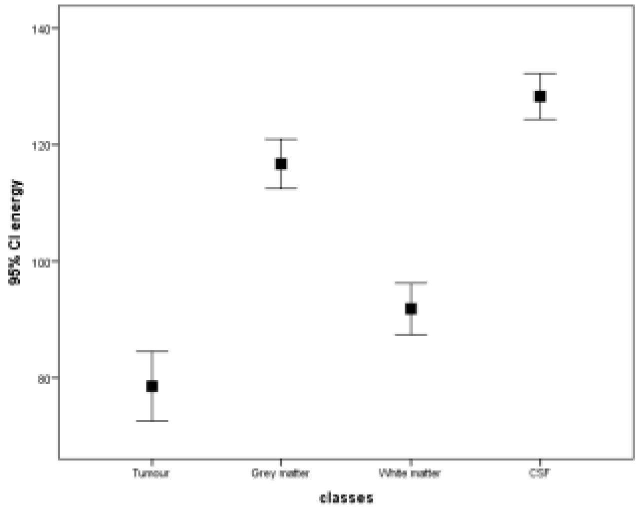

Figure 5: Error bar shows group classification energy based

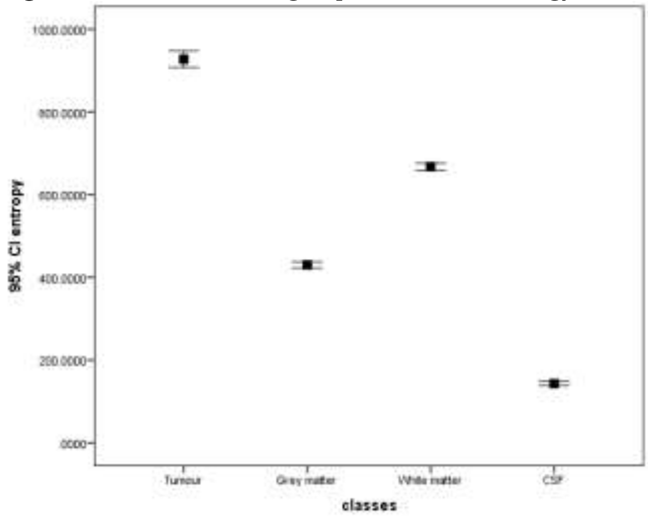

Figure 6: Error bar shows group classification entropy based

Figures (3), (5) and (6) error bars show a well differentiation between the classified group according to the mean, entropy ad energy features while there is a little bit interference when the classification based upon the skewness feature **fig (4)**

The sensitivity of this method in recognizing tumor was 82.6%, specificity 98.1% and the accuracy was 90.4% this shows higher performance in respect to kimia Rezaei and Hamed Agahi study

5. Conclusion

Sometimes it's very difficult to recognize the intracranial tumors from a non contrast CT image because the limitation of human eyes in differentiation between the nearby values of gray scale. By using textural method an excellent second opinion can be achieved.

Therefore the following equations can be used to classify the type of intracranial tissue.

Tumor=(10.207dA)+(0.046B)+(4.949C)+(0.065E)-(1.15F)-130.647
White matter =(10.722×A)+(0.025B)+(3.213C)+(0.088E)-(1.293F)-104.880
gray matter=(10.918A)+(0.028B)+(3.091C)+(0.068E)-(1.291F)-121.020
CSF= (7.465A)+(0.026B)+(1.545C)+(0.093E)-(0.920F)-50.799
(Conceder A=mean, B=average, C=skewness, E=energy, F=entropy)**.**

The result will be true positive when the equation gives the highest score after applying the values of the extracted features.

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Author Profile

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