ISSN 2348-1218 (print)
International Journal of Interdisciplinary Research and Innovations ISSN 2348-1226 (online)
Vol. 7, Issue 2, pp: (279-284), Month: April - June 2019, Available at: www.researchpublish.com

Brain Tumor Region Detection Using Fuzzy C-Mean Techniques

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Abstract: **MRI Imaging plays a very important part in brain tumor for diagnosis, analysis and treatment planning. It is valuable to specialist for detecting the earlier steps of brain tumor. Brain tumor detections are utilizing MRI images is a most difficult task, in view of the complicated structure of the brain. Brain tumor is an unusual advancement of cell of brain. MRI images proposed better contrast concern of various sensitive tissues of human body. MRI Image gives favored results over CT, Ultrasound, and X-beam. In this paper we propose image segmentation with k-means and fuzzy c-means algorithm. The experiment is performed utilizing MRI brain dataset. The evaluation result demonstrates that the fuzzy c-means algorithm go one better than k-means algorithm.**

Keywords: **Brain Tumor (BT) Detection, X-Ray, CT scan, IP, K-Means, Fuzzy C-Mean, MRI-Images.**

I. INTRODUCTION

Brain tumor or intracranial neoplasm is a mass of automatic growth of cells which grow in the brain [1]. There are two sorts of tumor in particular benign and malignant tumor. Benign tumor is non-cancerous as it has moderate growth and does not spread though malignant tumors are cancerous as it can spread quickly to different parts of brain as well as central nervous system [2]. Along these lines malignant tumors are significantly more harmful. Meningioma, lipoma, papilloma, adenoma are grouped under benign tumors, though, sarcoma, carcinoma, lungs tumor comes beneath malignant tumor. The existence of patients with benign tumor is 10 to 12 years. Patients with malignant tumor can live not over 14 months regardless of whether the treatment is going on. Early detection and diagnosis of brain tumor isn't critical for treatment and relieving yet additionally for percentage growth of tumor and follow-ups. Careful tasks, chemotherapy, radiation treatment and so on can be utilized for the treatment. MRI scan, CT scan, PET scan and different scan can be utilized to detect the tumor. MRI is having an added substance advantage since it doesn't emit ionizing radiation rays. In that capacity, no biological hazards have been accounted for with the utilization of MRI [3].

Detection of tumor from a brain MRI image is thus a vital step entangled on account of the complexities in the MRI image emerging because of the shape, size, location and distribution of tumor cells. Hence an automatic framework will help the radiologists for simple detection of tumor and in addition lessen the complexities. Statistical features like mean, correlation, variance, standard deviation, contrast, energy, entropy, homogeneity and so forth can be utilized for feature extraction of brain MRI image and along these lines can be utilized to recognize between a typical brain MRI image and a tumorous image.

II. BRAIN TUMOR AND MRI OVERVIEW

A. Types of MRI scans

These are T1, T2, Fluid Attenuated Inversion Recovery (FLAIR), Clinically Isolated Syndrome(CSE), Gradient Echo Sequences (GRE), Gradient (permits spatial encoding of MR signal) and so on. Of these, T2 and FLAIR images can detect the greater part of the tumor region as recommended by the specialists. Table 1 gives an outline examination about the T1, T2 and FLAIR image.

"Time of Echo (TE) is the time between the conveyance of the Radio Frequency (RF) pulse and the receipt of the echo signal". "Repetition Time (TR) is the measure of time between progressive pulse sequences connected to a similar slice".

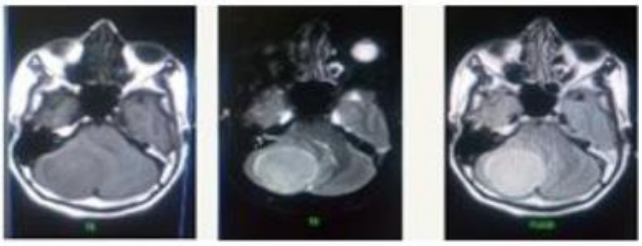

Figure 1: T1, T2 and FLAIR image classification of brain MRI

TABLE 1: COMPARISON OF MRI SCANS APPEARANCE

Tissue	T1-weighted	T2-weighted	FLAIR
White Matter	Light	Dark	Intermediate
Grey Matter	Intermediate	Intermediate	Light
CSF	Dark	Light	Dark
Edema	Dark	Light	Light
Tumor	Dark	Light	Light

Third regularly utilized arrangement is the FLAIR [4]. "The FLAIR arrangement is like T2- weighted image with the exception of that the TE and TR times are very long." By doing as such, abnormalities stay brilliant yet ordinary Cerebrospinal Fluid (CSF) is attenuated and made dark. It is extremely delicate to pathology and makes separation amongst CSF and variation easier [4].

B. Brain tumor detection factors

The vital parts of brain tumor detection are mass impact, signal force on T2-weighted images furthermore, FLAIR images, the manner in which how it upgrades i.e. homogeneous or heterogeneous, regardless of whether it is single region or numerous region and location of tumor. MRI scan can have three sorts of appearances i.e. hypodense, hyperdense and isodense. Hypodense has low density, hyperdense indicates high density or high vascularity and isodense has a similar density as that of brain. Consequently this may make a complexity to recognize brain tumor with accuracy. The kind of improvement tells the grade of tumor. The high grade of tumor will upgrade more after contrast is given. Table 2 gives comparison of T1 weighted image with T2 weighted image.

TABLE 2: COMPARISON OF T1 AND T2 WEIGHTED IMAGE OF BRAIN MRI

T1-weighted images	T2-weighted images
T1-weighted images are produced by using short TE and TR times	T2-weighted images are produced by using longer TE and TR times
T1 is longitudinal relaxation time	T2 is transverse relaxation time

III. LITERATURE SURVEY

In this section we presents existing work done in the field of MRI brain tumor detection.

[5], a computer based strategy for portraying tumor region in the MRI brain images is displayed. The algorithm combines steps for preprocessing, feature extraction and classification using neural network methods. The extraction of texture features in the detected tumor has been cultivated by using Gabor filter. These features are used to get ready and order the brain tumor using Artificial Neural Network Classifier. The structure basically improves the classification exactness of brain tumor discovery.

[6], mechanized recognition of brain tumors in magnetic resonance images (MRI) is a troublesome strategy attributable from the inconstancy and complexity of the location, size, shape, and texture of these injuries are talked about. Because of intensity likenesses between brain sores and ordinary tissues, a few strategies make use of multi-spectral anatomical MRI scans. Then again, the time and cost restrictions for social event multi-spectral MRI scans and some unique difficulties require developing a methodology that can recognize tumor tissues using a solitary spectral anatomical MRI images.

In [7], brain tumor diagnosis, clinicians arrange their medical knowledge and brain magnetic resonance imaging (MRI) scans to get the nature and pathological properties of brain tumors and to settle on treatment choices are utilized. Then again, physically recognizing and segmenting brain tumors in the present brain MRI, where countless scans taken for each patient, is monotonous and subjected to bury and intra eyewitness identification and segmentation variability. As result different methods have been proposed starting late to fill this hole, yet in the meantime there is no by and large acknowledged robotized strategy by clinicians to be used as a piece of clinical floor as a result of exactness and quality issues. In our methodology, a customized brain tumor location and segmentation framework that contains methods from skull stripping to identification and segmentation of brain tumors is proposed with fuzzy Hopfield neural network as its last tumor segmentation system. Through preprocessing, picture fusion and beginning tumorous slice classification, the last hybrid intelligent fuzzy Hopfield neural network algorithm based tumor segmentation, and tumor region acknowledgment and extraction is practiced.

In this paper [8], author proposes versatile brain tumor discovery, Image processing is used as a piece of the medical devices for location of tumor, just MRI images are not prepared to distinguish the tumorous region in this paper writers are using K-Means segmentation with pre-processing of picture. Which contains de-noising by Median filter and skull masking is used. In like manner we are using object naming for more point by point data on tumor region. To make this structure a versatile we are using SVM (Support Vector Machine), SVM is used as a piece of an unsupervised manner which will use to make and keep up the case for quite a while later.

Bbridging the gap amongst mathematical and clinical applications could be considered as one of the new troubles of medical picture investigation over the ten per years back.

In this paper [9], exhibits a progressed and jovial algorithm for brain glioblastomas tumor growth model. The brain glioblastomas tumor region would be separated utilizing a fast conveyance matching created algorithm based on global pixel wise information. Another model to reenact the tumor growth based on two noteworthy elements: cellular automata and fast marching method (CFMM) has been produced and used to appraise the brain tumor development amid the time. In view of this model, tests were done on twenty hypochondriac MRI picked cases that were decisively analyzed with the clinical part. The procured reenacted comes about were validated with ground truth references (genuine tumor development measure) using dice metric parameter.

IV. METHODOLOGY

In this area, the working of proposed framework is clarified in detail with algorithm. The proposed framework separated into different stages

- Pre-processing Stage
- Feature Extraction Stage
- Segmentation Stage
- Classification Stage

These stages are executed one by one for detection of brain tumor. The pre-processing stage includes different stages, for example,

- Normalization
- Skull Stripping
- Median Filtration

After preprocess, extraction of features are performed which incorporates features like

- Contrast
- Correlation
- Energy
- Homogeneity

After extraction of features, the segmentation of brain images are performed utilizing two prominent methodologies

- K-Means
- Fuzzy C-Means

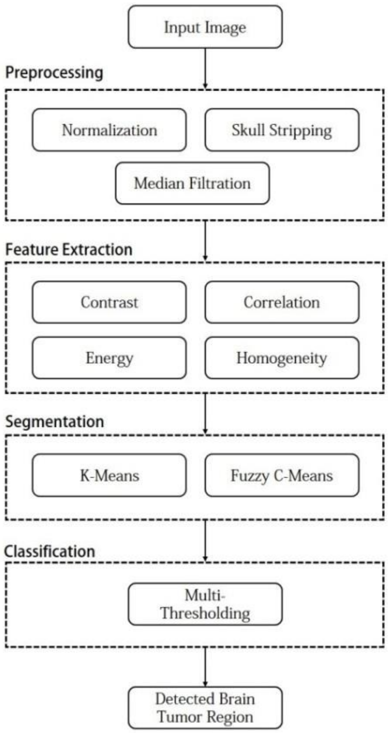

Fig 2: Shows the system architecture of brain tumor detection

A. Preprocessing

Brain MRI images are taken as process for detection and classification of tumors. The preprocessing step is done to expel undesirable noises so the classifier functions admirably with the given input image without influencing the efficiency. MRI images are initially converted to the grey scale image with the goal that the intensities are distinguished. At that point expulsion of other undesirable substance from the image are done which incorporate skull stripping. The skull stripping evacuate other piece of the image with the exception of the core brain image object.

B. Image Feature Extraction

Different features of the image are extracted for classification of region of image to have tumor content.

Contrast

Contrast estimates the amount of close-by changes in a photo. It reflects the affectability of the texture in association with changes in the intensities. It restores the proportion of intensity contrast between a pixel and its neighborhood.

Correlation

This part estimates how compared a pixel is to its neighborhood. It is the proportion of dark tone facilitates conditions in the photo. Feature esteems go from - 1 to 1, these extremes showing flawless negative and positive correlation independently.

Homogeneity

Homogeneity figures the similarity between pixels. A diagonal dark level co-event structure gives homogeneity of 1.

Energy

Energy also infers consistency, or angular second moment (ASM). The more homogeneous the photo is, the greater the value.

C. Segmentation

Segmentation is the strategy for separating the source image into various region. These region contain same intensities images.

V. RESULT

To evaluate our metrics we have used MATLAB. Image Processing apparatuses are utilized as a part of our evaluation. We have taken 3 dataset for brain tumor recognition. It is available online.

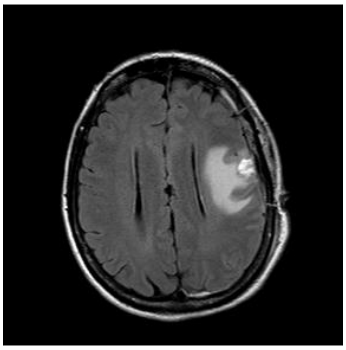

Fig. 3: TUMOR-01.dcm

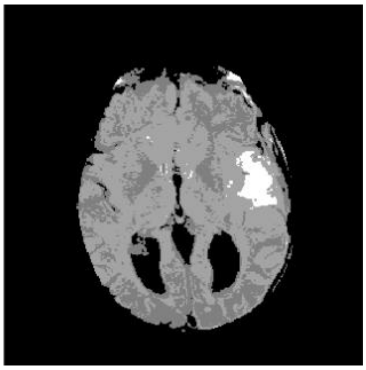

Fig. 4: Shows the output of K-Means with TUMOR-01 dataset

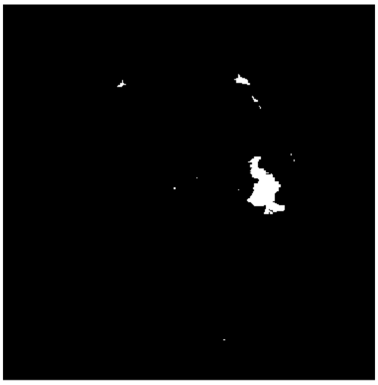

Fig. 5: Shows the output of fuzzy c-means with TUMOR-01 dataset

VI. CONCLUSION

From the images in figure 4 and 5 it is clearly visible that the Fuzzy C-Means algorithm outperforms the k-means algorithm as far as detection of tumor regions. The k-means algorithm needlessly chooses the tumor region of brain while compared with the ground truth. The fact of the matter is a long way from the outcome produced by the K-means algorithm. Fuzzy C-Means algorithm smartly selects the tumor region and yields just those regions which are important. The output of Fuzzy C-Means is the minimal of k-means, in light of the fact that the output produces by k-means contains in the yield of fuzzy c-means. Therefore, fuzzy c-means is better for MRI brain segmentation.

TABLE 3: Presents region of tumor in the brain

Attributes	TUMOR-01	
	K-Means	Fuzzy C-Means
Tumor Area (%)	0.021	0.012
ROI Compression Ratio (CR)	28.46	50.87
ROI CR Bits Per Pixel	0.28	0.15
Non-ROI After Compression (AR)	8.86	8.74
Non-ROI AR Bits Per Pixel	0.90	0.91

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