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Comparative Study of Various Algorithms for Edema and Brain Tumor Detection

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Abstract: Brain tumor and edema are the two brain related diseases that form abnormal tissues within the brain. Detection of tumors, edema can be done by using segmentation, feature extraction, other machine learning and deep learning algorithms. Past from many years the research is going on for efficient detection of brain tumors and edema. It is very important to detect the brain diseases in the early stages. Magnetic Resonance Image (MRI) scanning is the better method to identify the tumors and edemas within the human brain. These MR images shows the tumor and edema effected area within the given sample image. An expert system is required to detect the affected area. Many algorithms are proposed to check the issues in finding the abnormalities. In this paper, the comparative study is discussed about the performance of brain tumor and edema detection algorithms. Various machine learning (ML) and Deep Learning (DL) algorithms are discussed and different techniques are analyzed with different types of data.

Keywords: MRI, ML, DL, ELPA, ETEDA and MLDEA

Introduction

Image segmentation is most widely used in processing of various complicated images in various regions based on (image pixels). The main use of this segmentation is to identify the similar pieces within the given image which is more important to experiment. In images, segmentation is most widely used to find the items and limits (lines, curves, and circles etc). From the observation, image segmentation is the way that delas with the name of every pixel within the image to such an expanse that every pixel with same mark and also with visual attributes. After the segmentation is done the divided segments covers the overall images separates all the image pixels and normal and abnormal content in the image is separated.

Every one of the pixels in a community is tantamount close to a few reserve or enlisted

property, as an instance, concealing, power, or surface. Adjoining territories are interior and out novel close to the equal characteristic(s). Exactly while associated with a heap of images, every day in healing imaging, the ensuing systems after photo department are regularly wont to make 3-D recreations with the help of growth computations considered the 3-D squares.

Brain tumor is lopsided or out of control improvement of the cells in the brain. the occasion will be faster or greater sluggish passionate about the sort and country of the affected person's wellbeing. In mild of the skyline of a tumor, cerebrum tumors are organized into. Essential tumors and auxiliary tumors. The tumors which might begin in the cerebrum are referred to as critical tumors (like Glioblastoma Multiforme, Meningioma, Astrocytoma … then on) and consequently, the tumors which might unfold to the thoughts from starting every other piece of the frame are referred to as auxiliary tumors (like Metastatic tumors). Essential tumors are once more remote into kinds. they may be Benign and Malignant. Amiable is nonmalignant tumors and they handiest on occasion turns into the back. Though malignant tumors are dangerous and they end up faster. irrespective of the sort or class of the tumor, there may be a demand to well known the tumor in starting levels suddenly starting the remedy and for saving the life of the affected person.

Segmentation subdivides an image into regions passionate about the hobby of the appliance. While making use of the department, focuses have to be conveyed. in the first place, in the exam, if the irregularity is accessible and 2d is to get the sector in which inconsistency is. The more part of the department calculations are taken care of passionate about the ability esteems irregularity and similitude. The primary elegance manages the ability adjustments like edges in the photo and consequently, the following class is that the section of the pictures with predefined criteria's. Models for the following elegance are locale developing, Thresholding, and parting, and mixing. Division using aspect reputation is a vintage approach. Thresholding is an exceptional approach for the department in which pace can be a giant component for the applications.

Local binary patterns (LBP), K-means clustering (KMC) are exceptional strategies. They may be primary and their computational intricacy is low. For the bio-medical photo department, KMC and LBP offer the handiest outcomes. K-means clustering separates the pictures into diverse groups. These clusters are referred to as highlights of the photograph. LBP is an original and default classifier that is specialized within side the minor adjustments in the images with the aid of using small modifications that consider the relationship among a number of the adjacent pixels.

In the Existing framework for brain tumor Segmentation more than one calculation are proposed using K-implies calculation, aspect identity calculation, Thresholding calculations… then on Each calculation has their advantages and restrictions. By concentrating all of these calculations, here, for the duration of this research, an attempt is done for contrasting all of these calculations. Brightening assumes a massive

element for the thoughts of MRI images. While the mind tumor department because of the light impact, there may be a possibility of incorrect preference of the tumor area. Subsequently, the remedy for the affected person is given incorrectly, which similarly progressively damages the power of the affected person. For addressing this, LBP is thought of. All the above strategies with LBP are joined for buying the sector of the tumor locale, in the brain MRI images.

Related Work

In (Usman *et al.,* 2015) [1] proposed a dynamic brain tumor detection system. This technique followed the detection of brain tumor in three stages. For removing the noise and shaping the brain image is done in pre-processing stage, segmentation is used with threshold and Morphological operations are used to remove the false locations in segmentation. This method used to brain tumors and segments very accurately. In (Neda *et al.,* 2014) [2] presented automated segmentation by using the MRI scan images. Within the first stage they have applied pre-processing and removed unwanted regions such as eyes and scalp. Then the proposed algorithm specify the first location of the tumor. Finally, the brain tumor images are segmented. The corelation is given as R2 = 0.97.

(Grosso *et al.,* 2018) [3] "Developed a supervised learning algorithm with the pattern recognition method. They assessed the decision support system for diagnosis of brain cancer. This system is helpful for the early identification of the cancer and also for the classification of the disease level". (Sridhar et al., 2013) proposed a method that classifies the brain tumor images by using DCT and probabilistic neural network. Experiments are conducted on synthetic dataset that consists of 22 brain tumor images. This method analyzed very fast with better recognition rate when compared with the existing tumor detection methods.

(Angel *et al.,* 2018) [4] proposed an "Improved brain tumor detection". For brain tumor detection there are using three stages. These stages consist of image possession, preprocessing and improvement and also feature extraction, feature selection, classification and segmentation are performed in the last stage. The watershed algorithm is used for segmentation. This algorithm detects the accurate location of the tumor within the brain region. (Salai *et al.,* 2019) [5] developed the advanced brain tumor detection using scalp EEG and modified Wavelet-Independent Component Analysis (MWICA) with the integration of multi-layer feed forward neural network (ML-FFNN). By applying this method there is no other effects to the human body and this method is very low cost for finding the region of brain tumor. Based on the performance of algorithm, it is proved as better method.

Segmentation

Several techniques are available for segmenting the texture in images like K-means algorithm, Edge detection techniques, and Morphological operations K-means clustering is clustering or segmenting the images into K-regions.

That means it classify the data based on the features of the image. Each cluster is having the image

pixels of similar measures. Initially, objects of the images are randomly distributed and divided into K groups. Centroids for these clusters calculated. Euclidian distance between the cluster center points and the individual object in the group is calculated. Finally, objects are assigned to the certain cluster based on the minimum distance. Here, centroid position was estimated by random distribution of the data in the images. After distribution of the data to the clusters, centroid location was adjusted. This process is repeated until there is no change of the cluster points. K-means clustering is used in many applications like artificial intelligent, image processing, clustering, etc… Digital image is represented using the pixels values. Normally, images are having huge data. K-means algorithm is simple and efficient method for classifying the data for the images which are having the huge amount of data. Based on its simplicity and less computational time used the K-means algorithm for segmenting the brain tumor.

The purpose of using K-means is for Dimensionality reduction and accurate segmentation of the brain tumor. Dimensionality reduction is achieved by using K-means algorithm. Here, in K-means we are dividing the image into K regions. By which we can consider only the N/K pixels for calculation to obtain the brain tumor segmentation. Where, N is the total no of pixels in the image.

In image processing, identification of features is an important criterion's for analyzing the images. With these features structure, local changes and properties of the objects in images are estimated. For segmenting the image features, edge detection plays vital role. It identifies the local changes and boundaries of the edges in the images. Edges are identified and detected by applying filtering, enhancement, detection and localization. Filtering is used for improving the strength of the edges and for removing the noise in images. In enhancement, intensity changes are identified for local pixels using the gradient magnitude. Edge points are identified by the threshold, in detection step. Finally edge location and orientation estimated by using the localization step.

Generally, edge detection is done by gradient and laplacian operators. By considering the first derivative of the images, gradient is calculated and using the second derivative of the image laplacian method is derived. Many edge detection techniques are developed by several researchers by using these methods like Robert, sobel, prewitt etc... Canny edge detection is expensive compared to prewitt, sobel and Robert edge detection algorithms. For noisy conditions prewitt, Sobel and Robert are giving the better results.

Morphological operations are used to identify the shape, structure, edges, holes…etc. in the images. Several techniques are derived for identifying or segmenting the features in the images. Water shed segmentation, threshold segmentation, region growing and splitting etc. Dilation and erosion are two important morphological operations that are used for eliminating the irrelevant cells and for filling the gaps from the brain image. The relevant and broken segments are easily joined by this dilation. Using erosion, the interested portion of the image is displayed by using the structuring elements. With

this, the unwanted portion is removed and only the tumor affected part is displayed. The equations for the dilation and erosion were shown below.

Table 1 Comparison of various algorithms

Authors	**Year**	**Techniques**	**Features**
AbdelMaksoud , et al [6]	**2015**	Image segmentation approach using Kmeans clustering technique integrated with Fuzzy C-means algorithm	It is followed by thresholding and level set segmentation stages to provide an accurate brain tumor detection
Preetha, R., and G. R. Suresh [7]	**2014**	Performance Analysis of Fuzzy C Means Algorithm in Automated Detection of Brain Tumor.	Segmentation of images is basic and testing shows the better performance by observing the tissues in the human brain with MR images.
Halder *et al.*,[8]	**2014**	Detection of Brain tumor using Object labeling algorithm for Improved Segmentation	The tumor is detected by integration of Object labeling algorithm with K-means algorithm.
Zeljkovic *et al.*,[9]	**2014**	Automatic brain tumor detection and segmentation in MR images	It is explained that the MRI or CT scan experiments shows the required analytic devices which shows the better results if there are any tumor is present.
Salah *et al.*, [10]	2013	Fully Automated Brain Tumor Segmentation Using Two MRI	This method used 19 hand segmented original tumors that shows accuretly better

		Modalities."In Advances in Visual Computing	results by adopting exceptionally late strategy (STS) and also Dice coefficient
Dvorak *et al.*,[11]	**2013**	Using MR images the automatic detection is done for brain tumors.	The proposed strategy works with T2-weighted attractive reverberation pictures, where the head is vertically adjusted.
Vijay and Subhashini [12]	**2013**	An efficient brain tumor detection methodology using K-means clustering algorithm	This segmentation of this algorithm performed well when compared with the other algorithms to handle the brain images.

Table 2: Comparative results with proposed algorithms

Algorithms	Sensitivity	Specificity	Accuracy
Manual Segmentation	89.78	87.67	89.02
DCNN-F-SVM Model	90.87	88.67	91.21
ELPA	92.32	93.12	94.56
ETEDA	93.45	94.23	95.45
MLDEA	96.12	95.12	97.21

Conclusion

This paper explains about the various segmentation methods, classification methods and other algorithms that are used to detect the brain tumor and edema detection. Algorithms that are discussed and implemented by using various brain tumor and edema datasets are applied on Manual Segmentation, DCNN-F-SVM Model, Enhanced Learning Process Algorithm (ELPA), An Ensemble Brain Segmentation (EBS) integrated with Enhanced Tumor and Edema Detection Approach (ETEDA), MLDEA. From Table 2 it is observed that among all the proposed algorithms the most widely improved and better performance algorithm is MLDEA with the accuracy of 97.21, sensitivity with 96.12 and specificity is 95.12.

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