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AN EFFICIENT BRAIN TUMOR DETECTION USING EXPECTATION MAXIMIZATION ALGORITHM

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ABSTRACT
Brain tumor is a deadly disease. The detection of brain tumor from Magnetic Resonance Imaging (MRI) is a challenging one. The accuracy in the detection of tumor growth in different regions of brain depends upon the selection of various segmentation and feature extraction techniques. Although multimodal MRI images can provide complementary information in the tumor area, brain tumor segmentation is still a challenging and difficult task. Varying intensity of tumors in MRI makes the automatic segmentation of such tumors extremely challenging. In this paper, we propose a novel method for the detection of brain tumor growth. For preprocessing and segmentation of MRI images, K-means clustering and Expectation-Maximization (EM) algorithms are used. The features are extracted and the proposed techniques provide better performance for tumor detection.

INTRODUCTION
Abnormal cell growth formation within the brain leads to brain tumor. Two major classes of brain tumors are malignant tumors and benign tumors. The former one is cancerous tumors which involves the growth of abnormal cells that have the potential to invade other parts of the body. The latter one is noncancerous which lacks the potential to invade other parts of the body. Benign tumors have slower growth rate when compared with malignant tumors. Through a process called Tumor progression many types of benign tumors can become cancerous in nature by the course of time. Malignant tumors are mainly found in children whereas benign tumors are found in adults. Exposure to industrial chemicals and ionizing radiations are the major risk factors that cause the brain tumor. The most common symptom for brain tumors are headaches. Typical the headaches are worse in the morning, with improvement gradually during the day. They may rouse the person from sleep. These headaches may worsen with coughing, exercise, or with a change in position of body. These headaches do not respond to the usual headache remedies. Other symptoms includes changes in speech, vision or hearing, nausea or vomiting, changes in mood, personality or ability to concentrate and problems with memory. Diagnoses of brain tumor are done MRI scanning and are usually confirmed by a biopsy test. Normal brain images produced by an MRI will possess some of the basic properties: they will appear to be equal in proportion on both the left and right sides of the image on the paper as well as equal in size and coloration dimension for each section of the brain imaged. The abnormal brain images vary depending on the medical illnesses of the patient. This is because of the fact that the illness will affect different parts of the brain and will only be represented in that particular portion of the brain during image processing. One noticeable difference is that there is obvious inequality between two sides of the brain. The image shows a larger-sized portion of the bran on the left side in comparison to the right then this is a clear case of abnormality. Another abnormal image includes show color variation. Suppose if the MRI image has a portion of the brain that appears as white, then it can be an abnormal image. Moreover abnormal MRI images can look much darker in certain areas instead of the general muted shade of gray.
This paper is organized in the following manner: Section II describes the methodology which includes various techniques used and proposed block diagrams. Section III describes the implementation output obtained and finally concludes with section IV.

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METHODOLOGY

The details of the tumor and the shape of the tumors cannot be directly obtained from the MRI images. Therefore the MRI images are subjected to various image processing techniques, which are discussed as follows. The system overcomes the drawbacks of the existing systems. The Figure 1(a) shows the proposed block diagram for tumor detection. The input image is the Magnetic Resonance image (MRI) which contains the details about the human brain anatomy. This MRI is applied to the preprocessing block. The main aim of preprocessing is the removal of the low frequency background noise, normalizing the intensity of the individual particles images, removing reflections and masking portions of the images. The preprocessing block contains a series of processes. In preprocessing K-means clustering algorithm is used. After preprocessing the detailed segmentation of the MRI image is carried out by the Expectation-Maximization (EM) algorithm. EM is an iterative method for finding the maximum likely hood or maximum a posteriori estimate of parameters in statistical models. After detailed segmentation, the features are extracted. The essential features are obtained from the EM segmented output image and the tumor detection is performed on the image yields better performance.

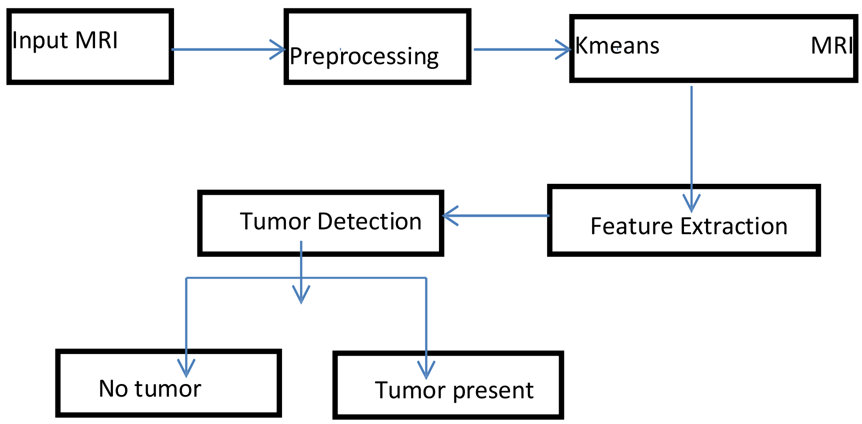

Figure 1(a) Proposed method block diagram for brain tumor detection

PROPOSED PREPROCESSING OF MRI

Here we propose a step by step preprocessing of the MRI image. The image preprocessing is a technique for enhancing the useful data contained in an image. It involves the conversion of an image into a digital form, and performs some operations in it, in order to extract some of the useful information from it. Figure 2(b)showsthe proposed preprocessing block diagram.

The MRI is basically colored image; it is basically an RGB image and the useful information about tumors cannot be retrieved from MRI directly. Therefore RGB image is converted to gray scale image. This process is known as gray scale conversion. After gray scale conversion MRI is subjected to high pass filtering.

High pass filter emphasize fine details of the image and it makes the image appear sharper. After the high pass filtering, median filtering is used. It is a nonlinear digital filtering technique which removes noise and it also preserves the edges while removing noise. K-means clustering is performed on the high pass filtered MRI image.

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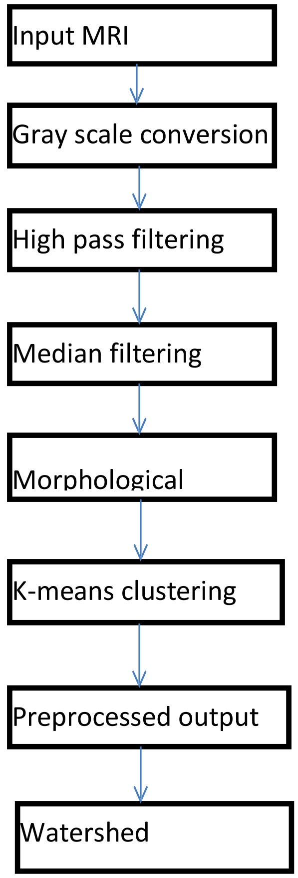

Figure 2(a) Proposed Preprocessin

K-MEANS CLUSTERING ALGORITHM

K-means clustering is a method of vector quantization. In data mining it for is a common method used clustering analysis. K-means clustering aims to partition n observation into K clusters in which each observation belongs to the cluster in which each observation belongs to the cluster with the nearest mean.

Algorithm for K-means clustering is as follows:

Step1: Pick K cluster centers, either randomly or based on some heuristics.
Step 2: Assign each pixels in the image to the cluster that minimizes the distance between the pixel cluster centers.
Step 3: Recompute the cluster centers by averaging all of the pixels in the cluster.
Step 4: Repeat steps 2 and 3 until the convergence is attained that is no pixels change cluster.

After performing K-means clustering, Watershed segmentation algorithm is used for the segmentation. Final process in MRI preprocessing is morphological treatments. There are mainly four types of morphological operations. It includes morphological opening, closing, dilation and erosion. Here morphological erosion is used. Initially morphological erosion was used for binary images but later extended for gray scale images also.

MRI SEGMENTATION USING EM ALGORITHM

The process of partitioning a digital image into multiple segments is known as image segmentation. These multiple segments are actually a set of pixels known as super pixels. The main aim of segmentation is simply to change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries. The outcome of image segmentation is a set of collectively cover the entire image or a set of contours extracted from the image.

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The most important application of segmentation lies in medical imaging such as to locate tumors and other pathologies, diagnosis, study of anatomical structure and surgical planning. The Expectation-maximization (EM) algorithm is an iterative method for finding maximum likelihood or Maximum a Posteriori (MAP) estimate of parameters in statistical models where the model depends on unobserved latent variables. The EM iteration alternates between performing an Expectation (E) step, which creates a function for the expectation of the log likelihood evaluated using the current estimate for the parameters and a Maximization (M) step, which computes parameters maximizing the expected log likelihood found on the E step. These parameters estimates are then used to determine the distribution of the latent variables in the next E step. The extracted features from the images are expected to contain the relevant information from the input data. Generally feature extraction involves the reducing the amount of resources required to describe a large set of data. Transforming the input data into a set of features is called as feature extraction. If the features extracted are clearly chosen it is expected that the features will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input.

BRAIN TUMOR DETECTION

EXPIREMENTAL RESULTS

The following section provides a detailed description of the results obtained in Brain tumor. Figure 3(a) shows an input MRI image. The corresponding gray scale output of the input MRI image is shown in figure 3(b). Figure 3(c) and figure 3(d) represents the High pass filter output and Median filtering output respectively. Figure 3(e) and figure 3(f) shows the watershed segmentation output and morphological erosion output respectively. The figure 3(g) shows the EM segmented output. Finally the figure 3(h) shows the tumor detected area using the proposed method.

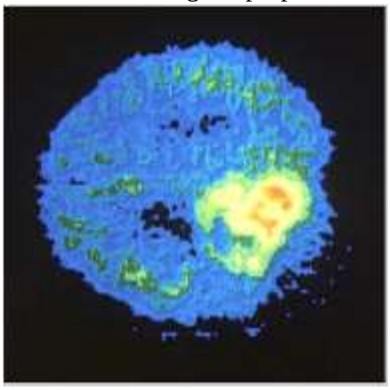

Figure 3(a) Input MRI image

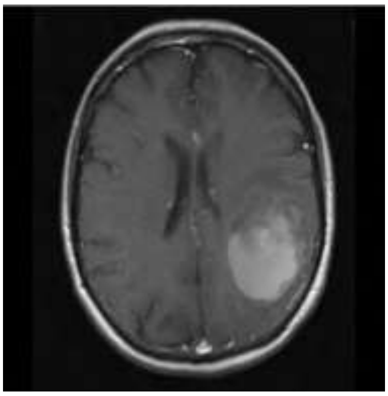

Figure 3(b) Gray scale output

Figure 3 (c) High pass filtering

Figure 3(d) Watershed segmentation

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Figure 3(e) Morphological Erosion

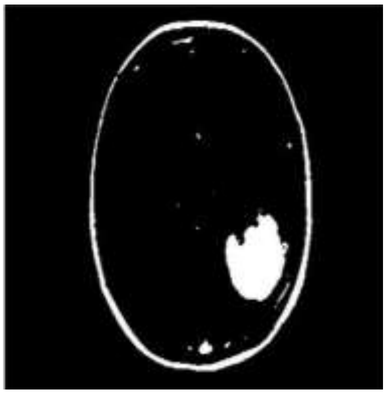

Figure 3(f) EM segmentation

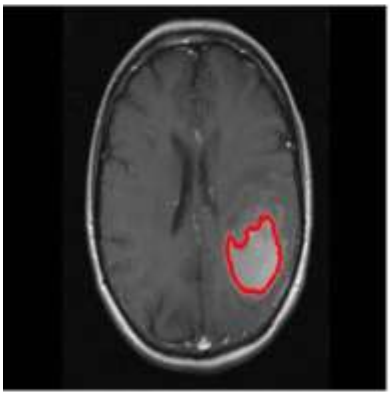

Figure 3(g) Tumor Detection

CONCLUSION

From the work it is observed that the proposed preprocessing including K-means clustering yields better result than the traditional preprocessing techniques or methodologies. The tumor detection using enhanced techniques such as EM segmentation yields better results. In future this work can be extended for detailed classification of tumors.

The blending of different types of fibres is widely practiced means of not only enhancing the performance but also the aesthetic qualities of textile fabric. Blended yarns made from natural and manmade fibres havr the particular advantage of successfully combining the good properties of both fibre components, such as comfort of wear with easy care properties. These advantages also permit an increased variety of products to be made, yielding a stronger marketing advantage.

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