A detemined way for detection of Brain Tumor Using Morphological operations and PSVM Classifier

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Abstract— Brain is highly specialized organ which helps as control center for functions of the body. Tumor is quick uncontrolled growth of cells. MRI imaging plays an important role in brain tumor analysis and diagnosis. Two dimensional MRI images are used to process and identify tumor region. MRI images are generally degraded with different types of noise. So these noise are removed using pre-processing techniques which improves the visual appearance of image without disturbing original image attributes. Pre-Processing will be performed at early stages before dealing with tumor detection and segmentation. MRI image segmentation will be performed to accurately identify region of interest from the images. Feature extraction will be done to capture visual content of image by using GLCM and region prop method. Later segmentation, shape and texture features associated will image will be extracted. Based on these extracted features brain image will be classified into abnormal and normal. The performance of this system is evaluated based on training performance classification accuracies to provide the precise and accurate results.

Keywords— Image processing, Magnetic Resonance Imaging(MRI), K-Means clustering, Thresholding, watershed segmentation, morphological operators, high pass filter, median filter.

1.INTRODUCTION

Brain is the most essential part of the central nervous system. Brain Tumor is uncontrolled development of tissues within the brain and inside the skull. Brain tumor diagnosis is quite challenging because of its complex outline, magnitude, position and appearance of tumor in brain. Brain Tumor detection is very compact in initial phase. There are different sorts of brain tumors which settles on the choice cofounded exceptionally. So grouping of cerebrum tumor becomes very important in order to overcome this difficulty. The principle reason for grouping is to classify the MRI image in order to tell whether it is normal or abnormal.

There are different kinds of test related to detect the brain tumor such as MRI, computed tomography (CT) scan, Biopsy and many more. Among all these test MRI image has greater potential for classification of brain. When compared to other image modalities like CT, MRI provides higher contrast and resolution for different brain tissues. A correct classification process of brain prompts right choice and give great and right treatment. Treatment might be diverse for each sort and as a rule it is dictated by

- ➢ Age, general wellbeing and medicinal history
- ➢ Tumor sort, area and size
- ➢ Tolerances for particular prescriptions and treatment

1.1 Brain Tumor:

Irregular development of cells which possesses space in the skull and interferes with ordinary cells of brain and creates pressure in the brain is known as brain tumor. Due to this pressure some tissues are shifted to skull which damages the nerves of other brain tissues. Classification of tumor is according to type of tissue and location of tumor. Classification is also done based on origin of and behavior of cell. Primary tumor are the tumors that are originated in the brain itself. They are benign (generous) and malignant (dangerous). Auxiliary (Secondary) cerebrum tumors are

tumors which are originated from the other parts of the body. They may be lung cancer, kidney cancer, breast cancer etc.
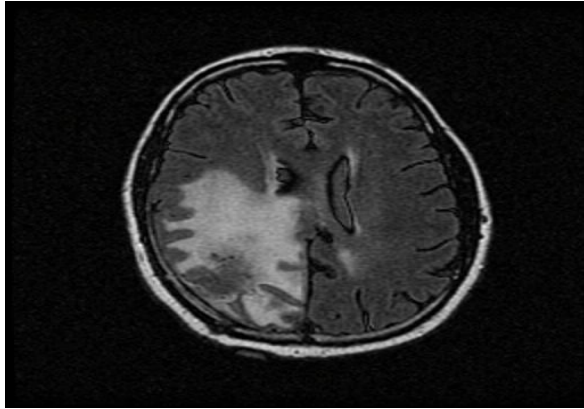
Figure 1.2: MRI image of abnormal brain

1.2 **Diagnosis of Brain tumor:** There are various modalities used to diagnose brain tumor like CT scan, MRI, and PET etc. The choice of modality for brain imaging is dependent on the purpose of examination. CT and MRI are most complimentary practices where each has its own strengths and weakness.

1.3 **Neurological examination:** The Neurological Examination is classification of transparent questions and analysis the particular delivery methods based on the nervous stemma. It is a popularly priced way of determining the methods.This method is partite into different peripheral whereas each component focused on different allotment of significant nervous system frame of mind, cranial nerves, cerebellum, sensory stemma, motor stemma and coordination.

1.3.1 **Magnetic Resonance Imaging:** Magnetic Resonance Imaging is a radiation-based system which characterizes the internal structure of the body in terms of intensity variation of radiated wave produced by the biological system when it is visible to radio frequency pulses. Magnetic resonance imaging is used for the identification of diseases related to soft tissues. Magnetic Resonance Imaging

(MRI) is one of the strong full imagining system, which is for the most part utilized for the treatment of cancer. Primarily MRI is used for recognize the most retral factor of the brain with high spatial constancy.

Advantages of MRI

➤ MRI images provide detailed diagnostic picture of most important organs and tissues in our body.

➤ MRI images of brain help physicians to lean size and number of tumor and exact location of tumor.

➤ MRI images are intermittently show the unique information but other tests are incapacitated to show like MRI show provide information about blood circulation throughout the body.

➤ There is no involvement of any kind of radiations in the MRI so it is safe for people.

Disadvantages of MRI

➤ MRI scan images involve noise.

➤ MRI is expensive.

2. Image Enhancement

Image enhancement is accomplished to enhance the visual appearance of image and to convey better portrayal of an image which is suited for examination by human Image enhancement helps to study the background information that is necessary to understand the object behavior. Image enhancement carried out on low quality images is interesting problem because of some reasons. In line to low contrast we cannot clearly extract objects from the dark background. Image enhancement techniques are classified into 2 categories.

2.1 Spatial based domain: The technique which directly operates on pixels. Advantages of this domain is simple to understand and low complexity. Disadvantages are lack of robustness. Ex- gray level transformation, log transformation, image negative.

2.2Frequency based domain: The technique which directly operates directly on transform coefficients of the image. Advantage of this technique is low complexity, ease of viewing. Ex- image sharpening, image smoothing, Noise reduction by domain filtering.

1.Histogram Equalization: Histogram equalization is typical method for upgrading the actualization of images. Histogram equalization is a gray-level transfiguration method that outcomes a yield image with a more or less flat histogram. Histogram equalization is a method by which image intensities can be changed to increase contrast. Histogram thresholding based techniques are extremely compelling when contrasted to other image segmentation techniques because they usually require a single go through the pixels.

2.Contrast Enhancement: Contrast enhancement is technique used to adjust the local contrast in different regions of the image so that information in dark or bright background are took and announce to the observer.

2.3Noise detection and filtering technique

Noise is defined as random variations in intensity of the image. Noise is provoke in sensors or through transmission channel all along acquisition process. Noise should be detached from the image in order to regain the authentic information from the image. It is important to remove noise while preserving edges.

2.4Morphological Operations: The term morphology means reassemble the structure or shape of an object. Morphological operations are correlated on binary images to get representation of shape of object. They are used in pre or post processing such as filtering, thinning or pruning or for getting a representation or description of the shape of objects or regions. The dominant morphological operations are erosion, dilation, opening and closing.

1.Erosion: is a morphology operation applied on the binary images which erodes away the boundaries of regions of foreground pixels .Areas of foreground pixels shrink in size and holes within. Erosion operator takes 2 inputs first is the image to be eroded, second is the structuring element.

2.Dilation: is a morphology operation which add pixels to the boundaries of objects in image to fill the holes. Dilation operator takes 2 slice of data as inputs. First is image to be dilated, second is structuring element. For exclusive background pixel structuring aspect is superimposed on input image so that origin of structuring element coincides with input pixel position. Basic effect of dilation on binary image is to enlarge the area of foreground pixels. The problem with using dilation operation is that operation might completely close up.
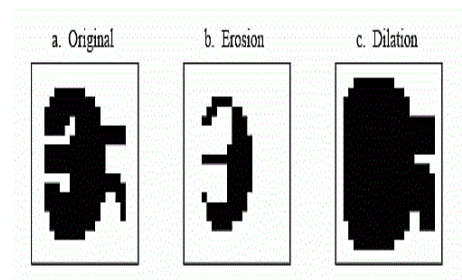

Fig.examples of erosion and dilation

2.4 Segmentation

Segmentation is process of detach a digital image into multiple regions (sets of pixels).The objective of segmentation to improve the portrayal of an image into something that is more important and simpler to examine. In an initial stage, the segmentation is used to separate the image in parts that characterizes an interest object that may be used in a particular study. Several approaches have been developed for segmentation. Some of those approaches are Edge Detection Method, Region Based Segmentation Method, thresholding Method, and Clustering Method.

1.Thresholding Method:

Threshold is one of the widely used technique for image Segmentation. Image isolation by thresholding is simple but strong method for isolate images having light objects on dark background. Thresholding process convert a most alluvial image into a binary image i.e. dividing the image pixels into

different regions and separate it from background based on chosen threshold value.

2.Region growing approach:

Region growing technique segments image pixels that are belong to an object into regions. Segmentation is transact situated on some predefined criteria. Two pixels can be assemble well-balanced if they have the same encompass characteristics.. The elementary scheme of the segmentation can be achieved through thresholding and fundamental labeling. Another method is to find region boundaries using edge detection. Segmentation process, then, uses region boundary information to quotation the regions. The main disadvantage of region growing approach is that it often requires a seed point as the starting point of the segmentation process. This requires user interaction. Due to the variations in image intensities and noise, region growing can result in holes and over segmentation. Thus, it sometimes requires post-processing of the segmentation result.

3.Clustering method: Clustering can be defined as unsupervised learning problem which partitions the data into number of clusters and organizes objects of information into clusters whose members are similar in some way. Two main methods used for clustering based segmentation are K-means and fuzzy C-means.

1.Adaptive K means:

1.It is a method that allows the division of a given data set without having to depend on the initial identification of elements to characterize clusters. This method is based on Euclidian distance.

2.Modified K-means method is based on reorganizing the clusters to better represent the partitions when new elements are added.

3.In Adaptive clustering technique cluster value k need not have to be specified. It is directly applied to image and centroid of different clusters is calculated.

4.Pros of this algorithm are its straightforwardness and low computational cost, which permits it to run efficiently on enormous datasets.

2.5 Feature Extraction: Features are the properties which describe about the whole image. So for image analysis feature extraction is required to reduce the processing time and complexity. Most of the image retrieval systems are based on shape, color and texture features. Shape refers to physical structure of an object. Texture refers to structural pattern of the surface area of the object. Shape and texture features are very important features for image retrieval because images may lose their ability when image or database does not have these attributes.

1. Texture Feature Extraction: Texture features are extracted using 2 methods, stastical and structural. In structural approach textures are repeated according to some rules or they may be random also. In stastical approach textures are random in nature they possess consistent properties. GLCM is one of the method used to extract the texture features. GLCM is 2D histogram of gray levels for a pair of pixels which is separated by spatial relationship. GLCM is a matrix where number of rows and columns are equal to gray level or image pixels in an image. For example given an image GLCM determines how often the gray levels occur in surface of that image.co-occurrence matrix is dependent on two parameters i.e. relative distance between the pixel pairs and relative orientation. Stastical methods are classified into 3 types i.e. 1st order (deals with one pixel), 2nd order (deals with pair of pixels) and higher order (deals with more than 2 pixels).

1.1st order features provide different stastical properties such as intensity of histogram of an image. These features are mean, variance, skewness etc.

2.2nd order features are extracted using GLCM. GLCM has 14 second order features are. Most important features among them are contrast, correlation, entropy and energy.

1. Shape Feature Extraction: Shape is most important property that is perceived about objects. Shape features allow to predict

more facts about an object compared other features such as color. Shape is a visual feature which is used to describe image content. Shape feature extraction are classified into 2 categories one is region based and other is contour based method. Shape features are also extracted using region props function in matlab. Region props measures properties of image regions. Some of the shape features are area, perimeter, roundness.

2.6 Problem Statement

Brain cancer is one of the dangerous disease in the world. So early recognition of the cancer is key to its cure. As human brain is very complex structure analysis of tumor in this region is difficult process. Medical images have different textures depending on area of body considered classification of images becomes challenging problem. Existing system uses different algorithms like k-means, fuzzy c-means for segmentation which has more disadvantages like it is slow, it expects user to specify cluster number, heavily dependent on initial cluster centers. A very difficult problem in classification is choice of features to distinguish between classes. So this current procedure is extremely time consuming and more inclined to mistakes. In order to overcome the drawbacks of existing system this project aims to provide an efficient system by using adaptive k-means clustering method for segmentation and SVM and ANN for accurate classification of MRI scan into normal and abnormal based on features. A correct classification of brain prompts right choice and give great and right treatment.

2.6.1   Generic Proposed Solution

1.Pre-Processing of data which includes gray scale conversion, resizing of gray scale images, contrast enhancement of images and elimination of noise from MRI image in order to improve the quality of image.

2.Segmentation is accomplished to segment the digital image into multiple parts so as to discover the region of interest from the image using Adaptive k-means method.

3.Feature extraction is done to extract shape and texture features from the segmented image using GLCM and region props method.

4.Classification is accomplished to identify the brain class based on extracted features using SVM and ANN classifier.

5.Performance is evaluated by comparing accuracy of both the classifiers.

2. LITERATURE SURVEY

[1].This paper describes that brain cancer extraction and its analysis are challenging tasks because brain is very complicated structure and it can be examined by skilled radiologists. Segmentation plays an important part in processing of medical images. MRI is clinical tool used for diagnosis of brain. This paper describes about relative study of three division methods which are used for tumor detection. The methods discussed are k-means clustering with watershed algorithm, optimized k-means clustering with genetic algorithm and optimized c-means clustering with genetic algorithm. Drawbacks of k-means method are discussed. This paper concludes that segmentation using K-means has not given accurate results because they are sensitive to initial cluster center, require prior initialization of clusters and fail to work with large datasets.

[2].This paper describes that segmentation of images is significant area in image processing while dealing with medical images. This paper describes an effective method i.e. combination of k-means and diffusion model for automatic brain tumor segmentation. This approach provided reliable results. This paper concludes that due to unsupervised approach this system is more efficient and less error sensitive. Main drawback of this system is it works only for minimum amount of data to get reliable results.

[3].This paper describes that MRI segmentation precisely perceive the tissue structures in these images. There are different segmentation approaches that exist to fragment the cerebrum. One of these method is not chosen because they require human interface for reliable segmentation. On other

hand unsupervised methods do not require human interaction and gives accurate segmentation results. In the light to this reality, a novel technique is built up. This novel technique is power based thresholding to offer the fringes between cerebrospinal liquid (CSF), dark matter (GM), white matter (WM) of brain.This papers concludes that good reasonable segmentation is achieved using this method. This system has worked only on normal MRI images of brain.

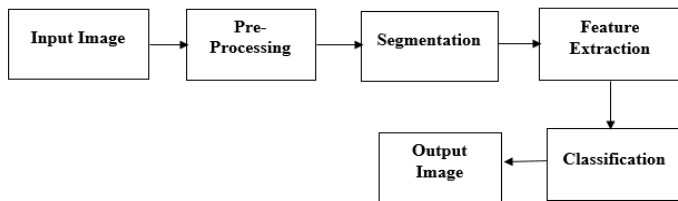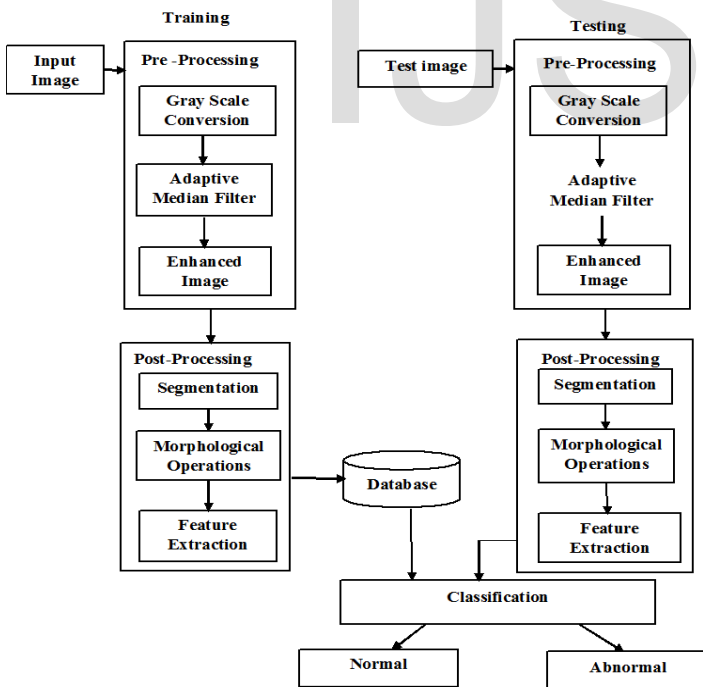## 3.SYSTEM DESIGN AND ANALYSIS

3.1 High Level Block Diagram

Figure 3.1: High level block diagram

3.2 SYSTEM ARCHITECTURE

1.Pre-Processing:

Basic pre-processing techniques are applied such as image enhancement, scale Changing, noise removal etc. The purpose of these steps is essential to enhance the image quality to get more surety and simplicity in identifying the tumor. Data that has been collected are varying in size which becomes difficult to process so each image is resized to uniform size 256X256 pixels.

1.1 Gray scale Conversion: MRI image is converted into gray scale image for further processing. For many image processing applications color images doesn't help us identify important features or edges from image. Gray scale conversion is done for following reasons:

1.Simplicity: many image processing work on plane of image data. Suppose we have RGBA image which has four planes and operation must be applied on each plane and then combine the results but gray scale image contain only one plane.

2.Data reduction: suppose we have RGBA image and it is converted to gray scale then we need to process only $1/4^{th}$ of the data compared to RGBA image.

3.The gray scale image contains all detailed information. It is easy to understand and don't have any ambiguities typical black and white images.

4.Gray scale reduces complexity from 3D pixel value(R, G, B) to 1D value.

1.2 Adaptive median filter: Noise is an unwanted signal which gets announced into data via any electrical system used for transmission and storage. Pixel which is different from its neighboring pixels and not structurally aligned with other similar pixels is considered as noise pixels. Adaptive median filter are used to define which pixels of image are affected by noise. Adaptive median filter categorizes pixels as noise by comparing each pixels with surrounding pixels. Then adaptive median filter replaces noisy pixels with median pixels of neighborhood. Main objective of adaptive median filter is to eliminate impulse noise, decrease distortions

1.3 Enhanced image: After removing noise, contrast of image is adjusted in different regions so that dark and bright regions are took and make it view better for humans. One of the contrast enhancement method is histogram equalization. Histogram is graphical representation of the image. Main objective of this method is to accomplish homogeneous histogram by using cumulative distributive activity of image.

2.Segmentation: Segmentation is process of splitting a digital image into multiple regions (sets of pixels).The objective of segmentation to improve or change the portrayal of an image into object that is more important and simpler to examine. After the pre-processing is done enhanced image is given as input to segmentation which separates it into different parts for ex- abnormal part from MRI image which is used for further processing. Clustering based segmentation method is used. Clustering is compassed positioned on different aspects of image such as color, intensity, texture. Adaptive K-means method is used to isolated the region of interest from the gray scale image. Adaptive K-means method is used since it is appropriate for biomedical image segmentation as number of group is known for particular areas of images of human anatomy. Segmentation is performed to excerpt various features of image which can be merged or split in order to build object of interest and to perform analysis.

3. Feature Extraction: Unique characteristics of an image are known as features. Feature extraction method decreases size of image data by obtaining necessary information from the segmented image. Main objective of any medical examination is tissue characterization which can be done by texture analysis. This module extracts meaningful features from the segmented image in order to categorize the brain MRI scan. The extracted features ought to offer characteristic of input type to the classifier by considering important properties of input image into feature vectors. Two different types of features are extracted from MRI image for classification purpose.

1. **Texture Features:** Texture features provides unique information about intensity variations in pixels of medical images. Texture features are extracted using GLCM method. Important texture features are autocorrelation, energy, covariance, contrast, entropy, homogeneity etc.

2.Shape features: shape is basic visual feature which describes the image content. Shape offers the geometrical information of an object in an image. Shape features play an important role in shape recognition and classification category. After image segmentation shape features are extracted from the segmented region using region prop function.

3. Classification: Classification is process of categorizing objects in images into separate classes which plays a vital role in medical imaging especially for tumor detection and classification. This module classifies the MRI scan into normal and abnormal based on extracted features using SVM classifier. The use of SVM involves training and testing phase. During training phase SVM module is trained with known data with the help of extracted features. Then SVM finds the optimal hyper plane to separate the training data to the class it belongs. During testing phase unknown data is given to classifier and it is classified into normal and abnormal by comparing test data features with trained data features.

4. IMPLEMENTATION

4.1 Algorithm for implementing Pre-Processing module

Proposed work is to implement Pre-Processing module which resize the image, converts it to gray scale image, abolish the noise from image and boost the contrast for further processing.

1.MRI image is taken as input image.

2.Input image is resized to 256 X 256.

3.After resizing it is converted to gray scale image.

4.Noise is removed from the image using adaptive median filter.

5.Contrast enhancement is performed using histogram equalization approach.

4.2Algorithm for implementing segmentation module

Proposed work is to implement segmentation which breakdown the pre-processed image into consequential sector. Segmentation process isolated the region of interest (i.e. tumor region) from other region.

Segment image (input image)

1. Load the K clusters and randomly preferred the position of centers for each cluster.

2. Partition the cluster into sub cluster.

3. Compute the gap between each pixel and seed point.

4. Category the pixels to the minimum distance cluster.

5. Modifiy the centroids.

6. Compute the new distance and again modernize the new centroid.

7. Repeat step 4 to step 7 until all the elements have been clustered.

8. isolated the images into k sub images acquiesce to clustered index image.

4.3 Algorithm for implementing classification module

Proposed work is to classify MRI scan into normal and abnormal based on features extracted using SVM classifier. Extracted Features are given as input to the SVM classifier to train the data. Classification is to identify the tumor class present in the image. SVM involves 2 basic steps training and testing.

1. Obtain the normal and abnormal image datasets.

2. Separate training set and testing set images.

3. Create labels(normal and abnormal) for SVM train to distinct class

4. Training SVM using extracted features which are stored in database.

5. Classify test set images by using stored features of trained images.

CONCLUSION AND FUTURE ENHANCEMENT

MRI brain classification is implemented using SVM and ANN classifier. Dataset contains normal and abnormal images. These images are pre-processed using filters to remove the noise and segmentation is carried out using adaptive k-means method. After segmentation features are extracted using GLCM region props technique and stored in database. These features are used as input for training SVM and ANN model. During testing stored features are compared with test image features and classified into normal and abnormal. The proposed system classifies brain type into normal and abnormal from images taken under different clinical circumstances using SVM and ANN. The experiential result shows that the proposed system shows a huge certainly rate and limited error rate. The proposed system is highly active for classification to classify normal or abnormal brain with high sensitivity, specificity and accuracy rate. In eventual the system can be upgraded to support other types of cancer images with few alteration either in segmentation and classification stage. It is alteration to support large number of input and should upgrade the certainty rate. To achieve this more number of appearance can be added with the utilization swarm based feature selection to improve the tumor detection and the classification result.