Identification of Brain Tumor from MRI using Fuzzy C Mean Segmentation Process

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***Abstract*—**MRI is an essential technique, in detecting the brain tumor. The tumor is an unfavorable intensification of harmful tissues which increase intracranial pressure Magnetic Resonance Imaging is a medical proficiency, mainly used by the radiologists for identification of an interior structure of the human body without any surgery. The technique proposed in this term paper is fuzzy c-means (FCM) and is compared with K-Means segmentation. Followed by tumor detection which will exhibit the existence of a tumor as Abnormal brain whereas the absence of tumor as a normal brain. In the dissimilar clusters obtained, it shows different elements of the brain such as white matter, gray matter, edema and tumor. The results were studied for different clusters.

***Keywords*—**Brain Tumor; Cancer; Clusters; Fuzzy C Means; Segmentation.

***Abbreviations*—**Fuzzy C-Means (FCM); Magnetic Resonance Imaging (MRI); Support Vector Machines (SVM).

I. INTRODUCTION

AUTOMATED and proficient diagnosis of medical images is very important. Computer and Information Technology are very much useful in medical image processing, medical analysis and classification [Ramteke & Khachane Monali, 4]. More frequently Medical images are generally obtained by X-rays and MRI. MRI is essential tool in the clinical and surgical environment due to superior soft tissue differentiation, high spatial decision distinction and it does not use any dangerous ionizing radiation which may have an effect on patients. Cancer develops in a part of the body when cells start on to grow out peculiarly Radiologists examine MRI Images based on visual explanation to identify the occurrence of tumor [Shweta Jain, 2]. There might be a opportunity when outsized dimensions of MRI to be analyzed then there is a chance of incorrect analysis by radiologists because sensitivity of the human eye decreases with swelling number of cases, primarily when only a small number of slices are unnatural.

Hence there is a require for accomplished automated systems for study and cataloging of medical images. The MRI image may control both normal and abnormal image.

This document deals among an usual move toward for brain tumor segmentation and detection. Fundamentally, the lump is an unrestrained enlargement of tissues in the brain. This lump, when spin into cancer be converted into potentially lethal. So in medical imaging, it is required to discover the perfect location of a lump and its type. For discovery and classification of brain lump, MRI is the best decision. A brain lump is an intracranial mass created by an unrestrained growth of cells whichever normally found in the brain such as neurons, cells, blood vessels, pituitary and pineal gland, lymphatic tissue, skull or spread from cancers for the most part positioned in other organs. Brain tumors are classified based on the spot of the tumor, the type of tissue involved whether it is benign or malignant.

1) Benign brain tumor: This type generally does not consist cancer cells and can be removed. It usually has an obvious border or edge. They don't spread to other parts of

the body. However, benign tumors can cause serious health issues.

2) Malignant brain tumor: This consists cancerous cells and thus also called as brain malignant cells. They grow up rapidly and can change nearby healthy brain tissues. This can be a hazard to life. Depending on the type of cell cause lump, surgeon groups brain lump by grade. In excess of time, a low-quality lump might develop into a high-quality lump. For opinion of brain lump, MRI provides wealthy information regarding the essential structure, enable quantitative pathological or clinical studies. The essential aspect that makes segmentation of medical images complicated is the difficulty and insecurity of the structure that is being imaged. It may be changed into impractical to position confident structures without thorough anatomical mastery. This makes common segmentation complicated, as the information must whichever be builds keen on the coordination or provided by the machinist.

Attribute elimination refers to various quantitative dimension of medical images classically used for supervisory about the pathology of a configuration or tissue [Ahmet Mert et al., 7]. In image processing, attribute taking out is a unique form of dimensionality shrinking. When the input data to an algorithm is too large to be processed and it is implicit to be shockingly avoidable then the input data will be transformed into a compact representation deposit of features. Transforming the input data set into the set of features is called feature withdrawal. If the take out features are carefully chosen, it is anticipated that the features position willpower remove the essential information from the input data in order to execute the preferred mission using this concentrated illustration as an alternative of the full size input.

The categorization method is separated into two parts i.e. the training and the testing part. Initially, in the training part well-known data are specified to the classifier for training. Secondly, in the testing part, unidentified information are given to the classifier and the categorization is performed behind training part. The accuracy rate and error rate of the arrangement depends on the effectiveness of the training.

Ming-Ni Wu, Chia-Chen Lin et al, proposed a color-based segmentation procedure that uses the K-means clustering technique to trail tumor substance in magnetic resonance (MR) brain images [Lashkari Amir Ehsan, 10]. The key idea in this color-based segmentation algorithm with K-means is to alter a given gray-level MR image into a color space image and then split the location of tumor stuff from other matter of an MR image by using K-means clustering and histogram-clustering. Experiments make obvious that the scheme can productively accomplish segmentation for MR brain descriptions to assist pathologists discriminate accurately abrasion size and area.

Xinhua Zhang et al proposed at these noninvasive analysis means enlarge the accuracy of the diagnoses, at the same time reduce the ache of the patients. Brain tumor diagnoses profit from these devises incredibly a great deal. In the brain MR image, the lump is exposed visibly. For the make well, the physician also wants the quantification of the lump region. This requires the unusual piece in the image to be segmented exactly; after that the segmented part can be calculated. This mission might not be handled by hands completely. compete processor can give grand help through this process. In this document we initiate one scheme to execute the assignment mentioned beyond. In this scheme, the brain lump MR figure is segmented semi-automatically. One deformable model-based technique is modified in the structure. And by the realistic user boundary, the segmentation can be intervened by user interactively at actual time.

Anupurba Nandi et al proposed deals with recognition of brain tumor from MR descriptions of the brain. The brain is the further most piece of the anxious scheme. Lump is a fast uninhibited growth of cells. Magnetic Resonance Imaging (MRI) is the instrument essential to diagnose brain tumor. The normal MR images are not that suitable for fine analysis, so segmentation is an important process required for proficiently analyzing the tumor descriptions. Clustering is appropriate for biomedical representation segmentation as it uses unsubstantiated knowledge. This manuscript effort uses K-Means clustering someplace the detected lump shows a few irregularity which is then rectified by the use of morphological operators beside with necessary representation dispensation techniques to gather the target of unscrambling the swelling cells from the standard cells [Somasundaram & Kalaiselvi, 8]. In accessible method, Support Vector Machines (SVM) were executed to brain image categorization [Zhang & Wu, 5; Othman et al., 6]. In this document attribute mining from brain MRI Images were agreed out by gray scale, symmetrical and surface features. The categorization procedure is separated into two parts i.e. The training and the testing part. Initially, in the training part identified statistics are given to the classifier for training. Secondly, in the testing part, unfamiliar statistics are given to the classifier and the categorization is performed later than training part. The exactness rate and miscalculation rate of the categorization depends on the effectiveness of the training. The Limitations are Time consuming, Inaccurate, Low reliability, Chance for error occurrence, Over-segmentation and sensitivity [Ahmed Kharrat et al., 9].

II. PROPOSED WORK

In proposed work, fuzzy c-means (FCM) algorithm is used and it compared with K-means segmentation. The planned scheme has mainly six modules: Image acquisition, pre-processing, segmentation, Post-processing, Feature extraction, Stage detection. In pre-processing filtering is performed on the MR representation. K-means and Fuzzy C-means algorithm are used in segmentation effort individually. Thresholding is used for attribute mining [Sonali Wadgure & Pooja Thakre, 1].

2.1. Advantages

- It does not consume much time and High reliability.
- There is no Chance for error occurrence.
- Speed of output extraction is high.

III. SYSTEM MODEL

The future system has mainly six modules: Image acquisition, pre-processing, segmentation, Post-processing, Feature extraction, Stage detection. In pre-processing filtering is performed on the MR image. K-means and Fuzzy C- means algorithm are used in segmentation work separately. Thresholding is used for feature extraction.

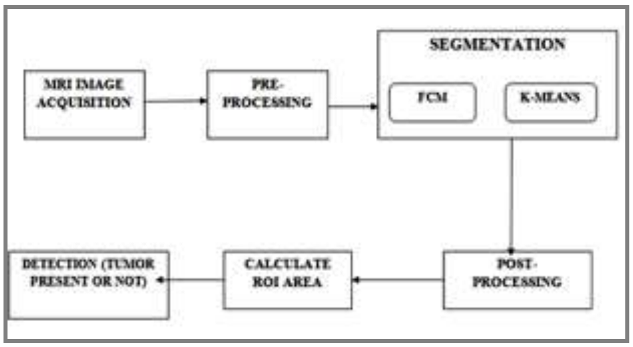

Figure 1: Proposed Block Diagram

IV. IMPLEMENTATION PROCESS

4.1. MRI Image Acquisition

- Data collection: The input MRI images have be together from different online open foundation database vacant for research work in DICOM, .MHA and .JPEG format.
- Image format Conversion: The greater part of the images collected was in .MHA format; hence they have been exported into a more usable format i.e. Medical
- Imaging Interaction Toolkit. For .DICOM image we used DICOM viewer software tool.
- Size normalization: The images have been acquired from different sources; hence, they are of changeable size. All imagery have been size normalized to be of size 255*255 pixels.

4.2. Image Pre-Processing

- By changing the image mode to gray-scale, remove the color components for FCM and K-MEANS
- Enhance the quality of the image by a median filter.
- Plot the histogram to study and investigate the strength allotment of the pixels.
- Intensity adjustment if needed.
- Histogram equalization.
- This section formats the input image as per the need of additional stages

4.3. Segmentation

In this paper, two main clustering based segmentation methods named Fuzzy C-Means and K-Means are compared. In clustering process, partitioning or grouping of set unlabelled model sector into a number of clusters such as the similar patterns are assigned to a group. These groups are the known as clusters.

4.4. Fuzzy C-Mean (FCM)

In Fuzzy C-Mean, the data has to be processed by giving the unfinished relationship worth to each pixel in the image. The relationship worth of the fuzzy set is in the range of 0 to 1. In fuzzy clustering essentially, a member of one fuzzy set be able to also be a element of other fuzzy sets in the same image. There are three basic features involved in categorization by a member function. The core is the full element of the fuzzy set, carry is the non-membership value of the set and margin is the partial membership with the value between 0 and 1. Generally, it is hard to find out whether a pixel belongs to a region or not. This is due to unsharp transition at expanse boundaries. Fuzzy separation is carried out by an iterative optimization of object function, with the keep informed of the attachment occupation and cluster centre. More rapidly the data point to the cluster centre the extra potential its relationship towards the particular centre. Compare to K-means, FCM provides improved results for overlapped region and data point which belongs to one or more cluster. It is attractive a abundant explore area.

4.4.1. Fuzzy C-Mean Algorithm Steps

1. Browse the file path; select the image starting database of MRI images to be processed (JPEG format)
2. Check if the image is RGB then convert it to gray image
3. Convert the image to double to increase the range of pixel values
4. For FCM, predefine the number of iterations and number of clusters
5. Get the size of the image
6. Convert input image matrix to a vector.
7. Randomly select the k cluster centre.
8. Calculate the fuzzy centre (vector) using the formula this equation

$$R_i = \sum_{i=1}^{N} xi.M_{ij}^{m} \quad \sum_{i=1}^{N} M_{ij}^{m}$$

9. Calculate the fuzzy membership function using this distance formula in Equation.

$$M_{ij} = \frac{1}{\sum_{k=1}^{C} \left(\frac{\|x_i - x_j\|}{\|x_i - C_j\|} \right)^{\frac{2}{m-1}}}$$

10. Repeat steps 8 and 9 until a minimum value is achieved in this equation

$$Ym = \sum_{i=1}^{N} \sum_{j=1}^{C} M_{ij}^{m} \|x_i - C_j\|$$

Where,
m - Any real number greater than 1,
Mij- degree of membership of x; in the cluster j,
Xi- data measured in d-dimensional,

Rj - d-dimension centre of the cluster (vector),

The update of Fuzzy membership Mij and the cluster

11. Terminate if stopping condition in equation

$$Image, I = \sum_{w=0}^{255} \sum_{H=0}^{255} [f(0) + f(1)]$$

Is true otherwise return to step 8.

12. Combine the membership grades and class values of clusters; map and reshape the respective pixels to form the final clustered image.

4.4.2. K-Means Algorithm Steps

1. Give the number of cluster value as k. (k = 5)
2. Randomly choose the k cluster centres.
3. Calculate the centre of the cluster.
4. Calculate the distance between each pixel to each cluster centre.
5. If distance is near to the centre then move to that cluster.
6. Otherwise move to the next cluster.
7. Re-estimate the centre.
8. Repeat the process until the centre stops varying.

V. DISCUSSIONS AND RESULTS

Thus the brain tumor is recognized by using the Matlab reproduction and it also classify which type of brain tumor is artificial. The future approach was tested on the database of 30 images out of which 6 images output is discussed. The recorded entities were as follows: the image name, Area of tumor, execution time and the exposure choice (tumor present and tumor absent).

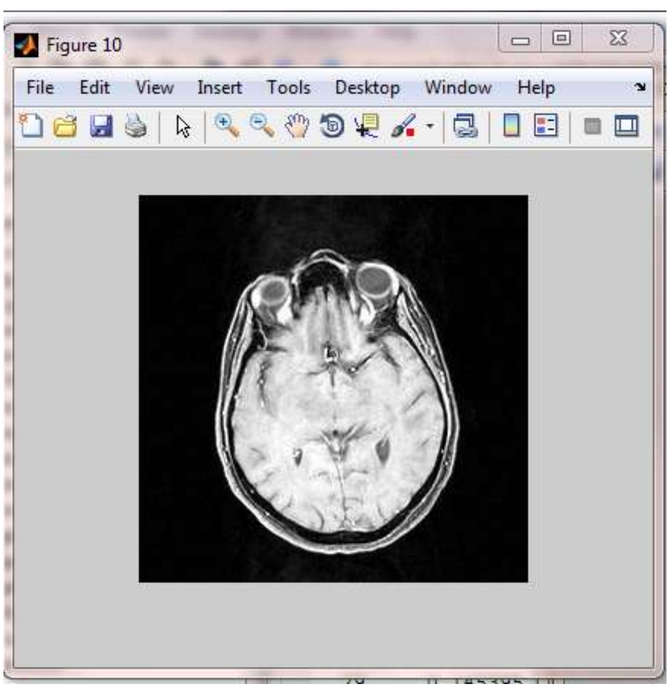

Figure 2: Normal Image

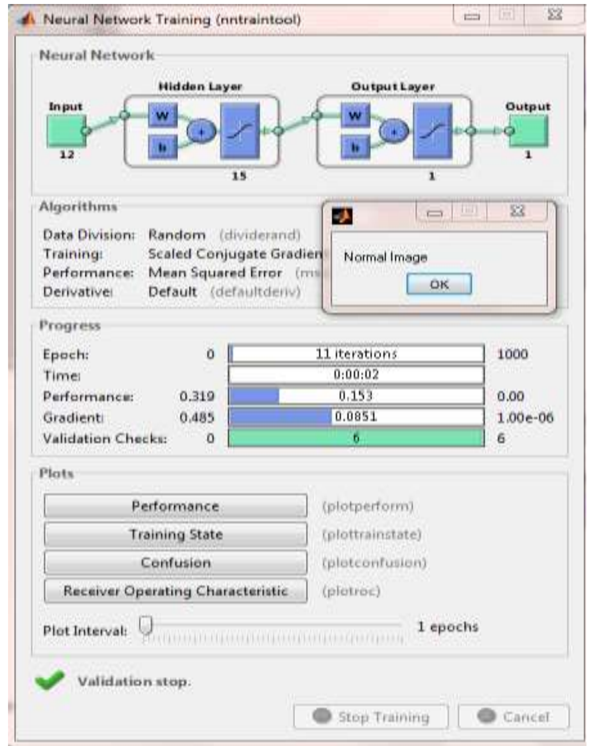

Figure 3: Performance of Neural Network Training for Normal Image

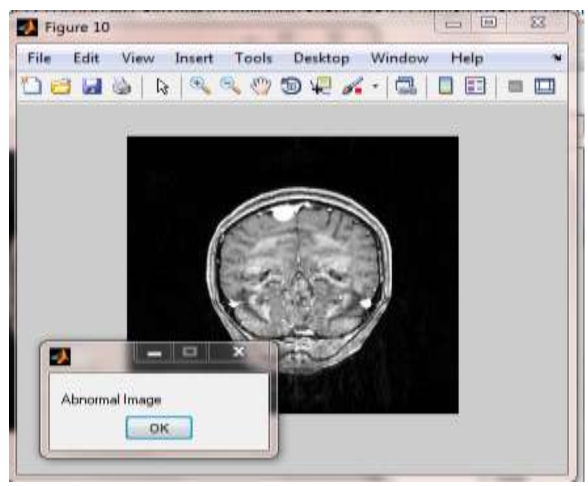

Figure 4: Abnormal Image of Brain

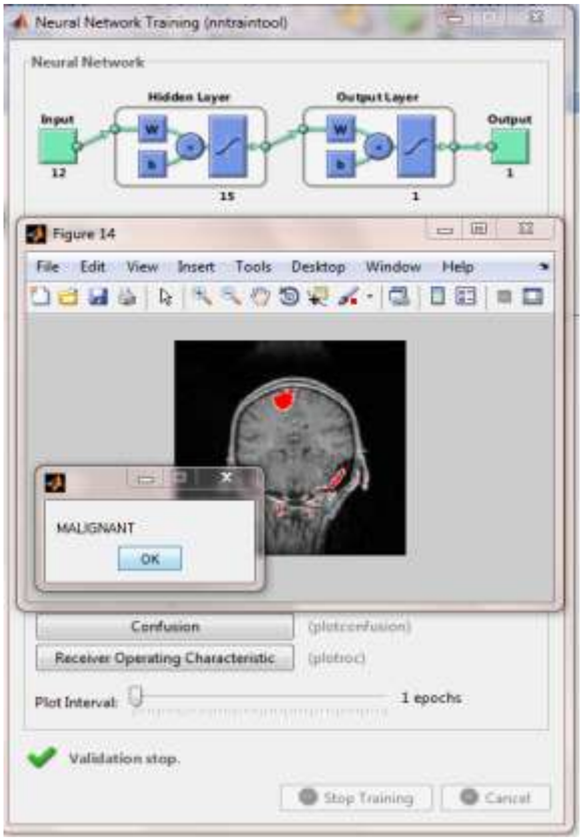

Figure 5: Malignant Type of Brain Tumor

VI. Conclusion and Future Scope

In this paper an algorithm using Matlab GUI has been industrial for the segmentation and detection of brain tumor from MRI brain scanned images based on a range of operations like pre-processing, Fuzzy C- means and K-means segmentation, feature extraction [Janki Naik & Sagar Patel, 3]. The two algorithms K-means and FCM algorithm were effectively implemented. Assessment of these algorithms is done on the basis of time, lump area and reproducibility, PSNR, RI, GCE, and VOI. The results obtained finish off that the effectiveness of FCM is comparatively better than K-means algorithm for overlapped datasets.

In future, this system can be implemented with some other algorithm which will give more accuracy and save more time.

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