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RESEARCH ARTICLE

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A FULLY AUTOMATED AND ELEGANT METHOD FOR SEGMENTATION AND CLASSIFICATION OF BRAIN MRI IMAGES USING K-MEANS ALGORITHM AND ANN

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ABSTRACT

Computational applications are gaining significant importance in the routine life. Specially, the tradition of the computer aided systems for computational biomedical applications has been explored to a higher extent. Detection of brain tumor is the most common fatality in the current scenario of health care civilization. Automated brain disorder analysis with MR images is one of the specific medical image analysis methodologies. In this paper, segmentation is done by improved K -means algorithm with dual localization methodology. It allows the segmentation of tumour tissue with accuracy and reproducibility comparable to manual segmentation also it reduces the time for testing. At the end of the process the tumour is extracted from the MR image interms of position and shape. The proposed system uses computer based procedures to detect tumor blocks or lesions and classify the type of tumor using Artificial Neural Network in MRI images of different patients.

Key words- Magnetic Resonance Imaging(MRI), Brain tumor, Preprocessing, Thresholding, Feature extraction.

I. INTRODUCTION

This paper proposes the concept of automated and elegant method for segmentation of brain MRI images using k-means algorithm. Medical imaging is the technique and process used to create images of the human body (or parts and function) for clinical purposes or medical science (including the study of normal anatomy and physiology).A brain is viewed by CT or MRI scan. MRI scan is more secure than CT because it uses magnetic field and radio frequencies. For early detection of abnormalities in brain, MRI imaging is the most capable imaging technique since MRI image acquisition parameters can be adjusted for generating high contrast image with different gray level for various cases of neuropathology. Therefore, MRI image segmentation stands in the upcoming research limelight in medical arena. Here the segmentation process is carried out by K - means and dual localization process. Finally the dimension of the tumor in two dimensional is determined. The forthcoming sections of the paper deal with related research done in section 2 and the proposed

methodology of segmentation on MRI image in section 3.

II. LITERATURE REVIEW

The modified region growing technique is used for detection of brain tumour. This technique compares the normal region constraints and the orientation constraints(GaneshMadhikar.,2013). Then feature extraction is carried out by using area, mean, correlation, covariance factors. The classification of the tumor is extract by neural networks. If noise is present in the input image means it provides over segmentation. This is the main drawback of this technique.

Thresholding method is widely used for image segmentation. This is simple and valuable segmentation method (Harneet Kaur.,2012) for images with different intensities. It detects the tumor based on the threshold value. The input image contains 0 to 255 gray scale values. Output image for thresholding consists of only two gray values .That is white as 1 and black as 0. Sometimes it ignores the tumor cells. So it cannot extract the tumor from the image. This is the main problem of the existing system. A major weakness of this method is fails to deal with multichannel images.

Fully automatic brain tumor segmentation based on multi-modality MRI and level-set(Sami Bourouis.,2011) for three-dimensional magnetic resonance images. In preprocessing, which can remove only high-frequency noise, preserve edge, and should not affect relevant major geometrical features. Here, a non rigid registration step is performed to match different MRI images. After fully automatic initialization step is to create an initial surface for the tumor that must be able to derive locally the level set evolution. So recall that T1-weighted MRI is commonly used for detailed imaging of anatomy but do not distinguish tumor tissue well. Then Level-set Segmentation Step is to extract accurately brain tumor. An efficient detection of brain tumor from cerebral MRI images(S.Taheri.,2009) using Wavelet transform decomposition. The methodology consists of three steps: enhancement, segmentation and classification. In enhancement process the quality of the image is improved. Then by using mathematical model the contrast of the image is increased.After apply Wavelet transform MRI images are decomposed. At last, the k-means algorithm is implemented to extract the guarded regions or tumor.

An automated multi-stepped algorithm for detecting the boundary of brain tumor from the MR images (Dr.S.R.Gupta2013) using, Intelligent Water Drops algorithm(IWD). Preprocessing of the input image to remove noise. Then the Initial Contour(ROI) is developed. Brain tumor boundary segmented by IWD Algorithm. Finally the results are compared with existing segmentation techniques.

An automatic brain tumor detection and localization framework that can detect and localize brain tumor in magnetic resonance imaging(Ed-EdilyMohd. Azhari.,2012).This technique has the following steps: image enhancement, pre-processing, edge detection, modified histogram process and morphological operations. Edge detection is used to find the boundaries of the object. Histogram converts the gray level image to a binary image for individual pixel values. Morphological operation has dilation and erosion process. Dilation perform vector addition. Erosion executes vector subtraction then the tumor is detected.

III. PROPOSED SYSTEM

The performance of the proposed system is evaluated by using brain MRI images. The implementation process is explained below.

A. Input Image

The brain MRI image of the patient is taken as an input image for the proposed system.

B. Preprocessing

Preprocessing step convert the image in to gray conversion and performs filtering and sharpening the edges in the image. In this paper wavelet and wiener filter is used for preprocessing. It performs the following processes.

i)Resize an image into general format(512x512)
ii)Convert RGB into gray image
iii)Remove the scull and unwanted parts

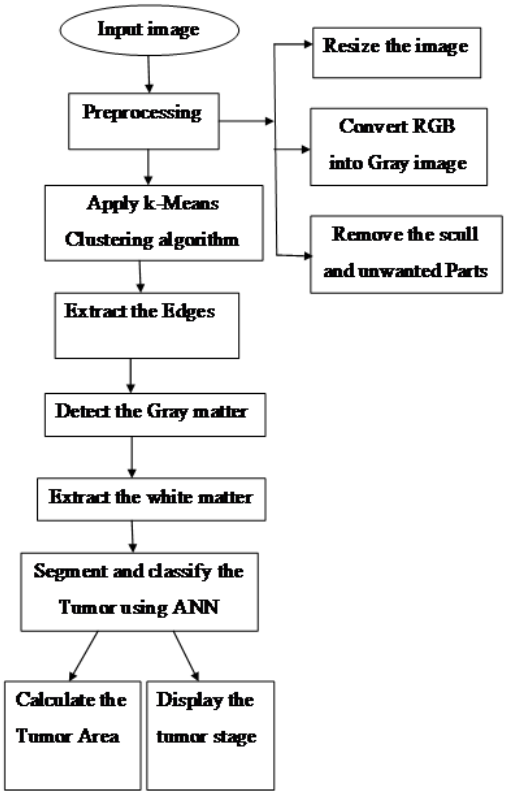

Fig-1 Proposed system

C. k-Means Clustering Algorithm

The k-means clustering algorithm is a simple and effective segmentation method for detection of tumors in brain. In this algorithm, initially the input image is converted into standard format 512 X 512, then the total no. of pixels are calculated. Then covert 2D image into 1D and create number of clusters depends on user. The k-means algorithm defines the number of clusters k. Then k-cluster centre are chosen arbitrarily. The k-means equation is shown below.

$$W(C) = \frac{1}{2}\sum_{k=1}^{K}\sum_{C(i)=k}\sum_{C(j)=k}\left\|x_i - x_j\right\|^2 = \sum_{k=1}^{K} N_k \sum_{C(i)=k}\left\|x_i - m_k\right\|^2 \quad (1)$$

The distance between the each pixel to each cluster centres are calculated by simple Euclidean function. Simple Euclidean function is described by the following equation

$$C(i) = \arg\min_{1\le k\le K}\left\|x_i - m_k\right\|^2,\ i = 1,\dots,N \quad (2)$$

Single pixel is compared to all cluster centres according to the distance. The pixels are associated with the nearby cluster. The pixel is moved to particular cluster which has shortest distance among all. Then the centroid is re-estimated. Again each pixel is compared to all centroids. The process continuous until the centre converges.

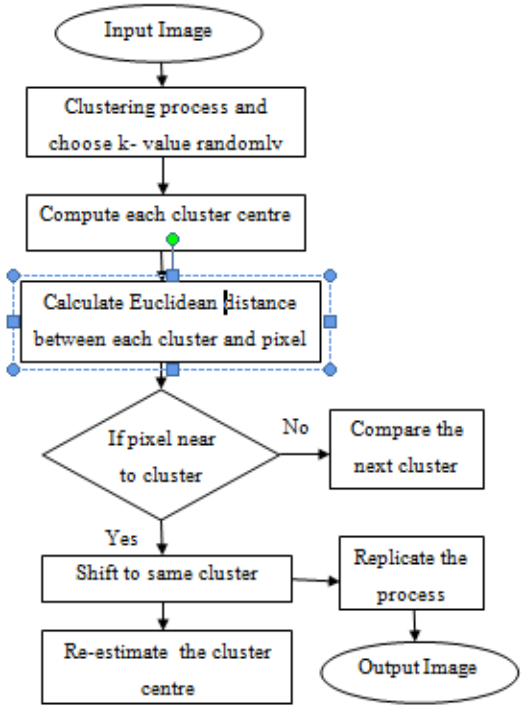

Fig-2 k-Means algorithm Flowchart

D. Feature Extraction

The input data will be transformed into a reduced representation set of features (features vector). Transforming the input data into the set of features is called feature extraction. Principal Component Analysis based feature extraction is described as below. Thresholding can be used to create binary images from a grayscale image. Then the extraction process is used to detect connected regions in binary digital images, although colour images and data with higher dimensionality can also be processed. Template matching is a technique, for detecting the edges in extracted image. Finally, the hough transform is to find imperfect instances of objects within a certain class of shapes and it is extended to identifying positions of arbitrary shapes, most commonly circles or ellipses.

E. Artificial Neural Network(Ann)

The ANN is used to classify the stage and area of the tumor by comparing the inputs and outputs through Feed forward algorithm. It has three layers for the comparison process. The input units represents the raw information that is fed into the network. Each hidden unit is determined by the

actions of the input units and the weights on the connections between the input and the hidden units. The behavior of the output units depends on the action of the hidden units and the weights between the hidden and output units.

F.Classification of brain tumor using ANN

Classification of brain tumor using Magnetic Resonance Imaging (MRI) is a difficult task due to the variance and complexity of tumor. This paper presents Neural Network techniques for the classification of the magnetic resonance human brain images. The proposed Neural Network technique consists of following three stages, preprocessing, dimensionality reduction, and classification.

In the first stage, the MR image is captured and converted into data form (encoded information that can be stored, manipulated and transmitted by digital devices), in the second stage dimensionally reduction has takes place through Principles Component Analysis (PCA), then in the classification stage the Back-Propagation Neural Network has been used as a classifier to classify subjects as normal or abnormal MRI brain images.

IV. EXPERIMENTAL RESULTS

The proposed system has been carried out by MATLAB. Because it is easy to execute and best tool for high-productivity research, development, and analysis. Sample input image is taken for the segmentation process. In pre-processing resize the image, conversion of RGB to gray image and scull, unwanted portions are removed that is shown in Fig 4,5,6. After that k-means algorithm is used for the segmentation process in Fig 7. And the feature extraction is carried out by extracting gray and white

matter in Fig 8,9,10,11,12. Finally the stage and area of the tumor is classified by ANN in Fig 13,14.

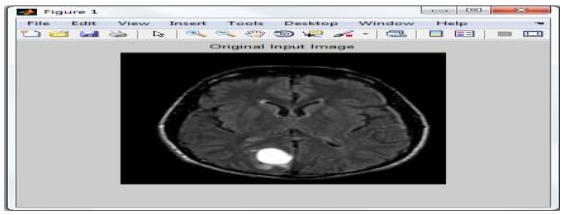

Fig3- Sample input brain image

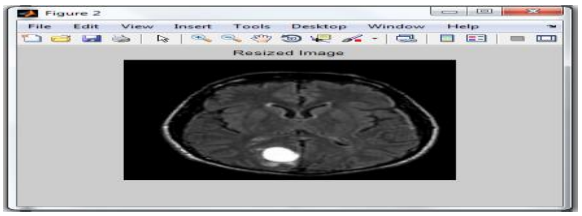

Fig4-Resizing the image into user defined size

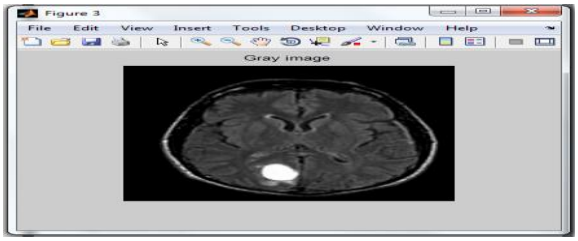

Fig5-Converting RGB into Gray image

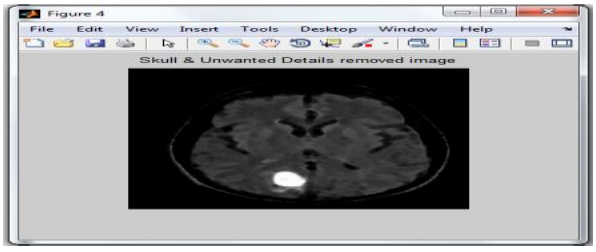

Fig6-Removing the scull and unwanted Parts

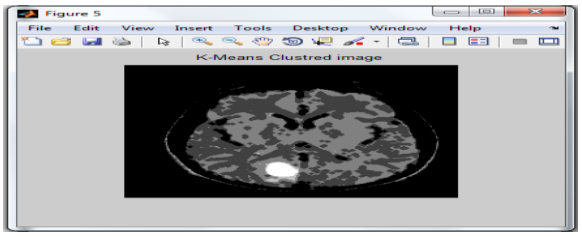

Fig7-Applying the K-Means Clustered algorithm

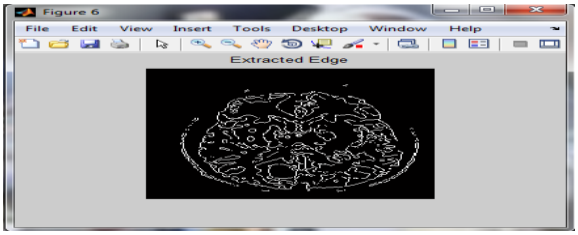

Fig8-Extracting the Edges on the Clustered image

Fig 9- Gray matter extracted image

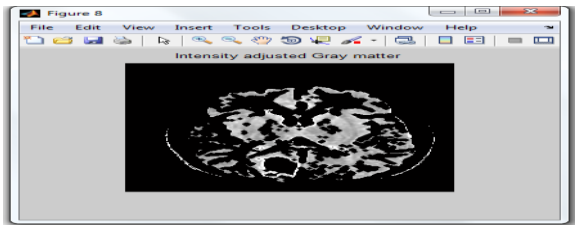

Fig10-Adjusting the Intensity Gray matter

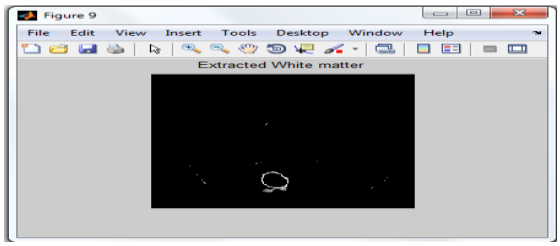

Fig11-Extracting the white matter from the adjusted image

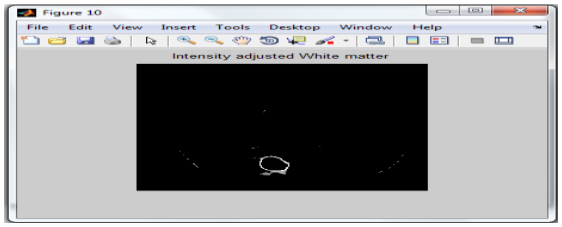

Fig12-Adjusting the intensity of the white matter

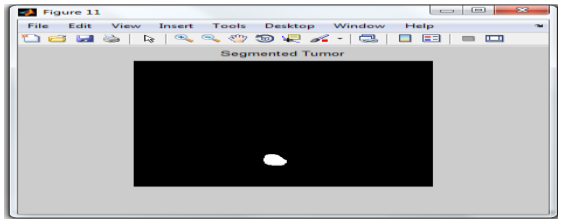

Fig13-Segmenting the Tumor Separately

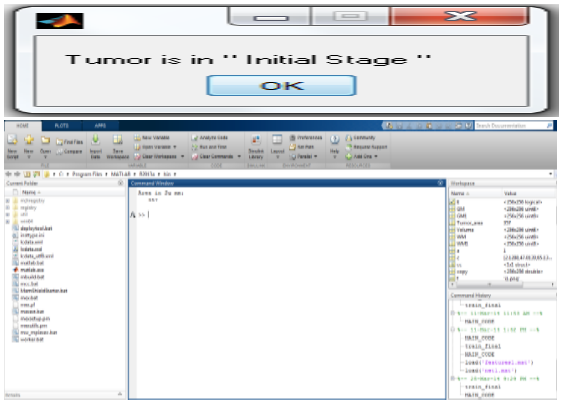

Fig14-Calculating the Tumor Area and displaying the stage of the Segmented tumor

V. CONCLUSION

Image segmentation is extensively used in numerous biomedical-imaging applications, e.g., the quantification of tissue volume, study of anatomical structure, diagnosis. At diagnosis, the tumor is a complicated and sensitive task; therefore, accuracy and reliability are always assigned much importance. The method for segmentation proposed here overcomes the drawbacks of the conventional k–means algorithm and gives very satisfactory result both from qualitative and quantitative perspective. Moreover the success rate of the segmentation in images of brain MRI taken from all the three angles is quite high and satisfactory. The real time execution time in the test cases is less than 9 seconds in almost all the cases and thus can be said to be good as per the current industry standard is also very less as compared to manual process. So, based on the above discussion it can be claimed to be a novel segmentation approach in its family of unsupervised clustering approach.

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