Detection of Brain Tumor using Kernel Induced Possiblistic C-Means Clustering

D.Napoleon[#1], M.Praneesh[*2]

[#1]*Assistant Professor, Department of Computer Science, Bharathiar University, India*

[#2]*Assistant Professor, Department of Computer Science, Sankara College of Science and Commerce, India*

Abstract *— Brain tumor is a major health problem throughout the world. Magnetic resonance imaging (MRI) scan can be used to produce image of any part of the body and it provides an efficient and fast way for diagnosis of the brain tumor. In the Proposed method an efficient detection of brain tumor region from cerebral image is done using Kernel Induced Possiblistic C-means clustering and histogram. The using Kernel Induced Possiblistic C-means clustering algorithm finds the centroids of the cluster groups together the Brain tumor patterns obtained from MRI images. Segmentation result shows the extract tumor region.The performance evaluation of the proposed system is evaluated and compared with existing approaches.*

Keywords— *Tumor, KPCM Algorithm, Statistical Measures, histogram equalization.*

I. INTRODUCTION

Brain tumor is composed of cells that exhibit unstrained growth in the brain. Brain tumor nature is malignant since it takes up space and invades brain tissue which is required for vital body function. Due to the invading nature of brain tumor it affects one of most important in the body (5). Image of intensity in MRI depends upon four parameters. One is proton density (PD) which is determined by the relative concentration of water molecules. Other three parameters are T1, T2, and CSF, relaxation, which Reflect different features of the local environment of individual protons. Magnetic Resonance Imaging is a medical imaging technique. Radiologist used it for the visualization of the internal structure of the body. MRI provides rich information about human soft tissues anatomy.MRI helps for diagnosis of the brain tumor. Images obtained by the M Magnetic Resonance Imaging are used for analysing and studying the behaviour of the brain.

The histogram equalization, the decomposition of Magnetic Resonance Imaging images suspect Zone or Tumor and extraction of location tumor .It improves contrast and goal of histogram equalization is obtain a uniform histogram. Segmentation method implements (14) the proposed clustering algorithm for detect tumor extract region from MRI image.

II. PROPOSED SYSTEM

In this proposed method Kernel Induced Possiblistic C-Means clustering is implemented with histogram equalization method. Image segmentation covers this objective by extracting the abnormal portion from the image which is useful for analyzing the shape of the abnormal region.A brain Image consists of cluster(15) i.e. gray matter (GM), white matter (WM), cerebrospinal fluid (CSF) and tumor region. The figure 1 shows proposed segmentation Method.

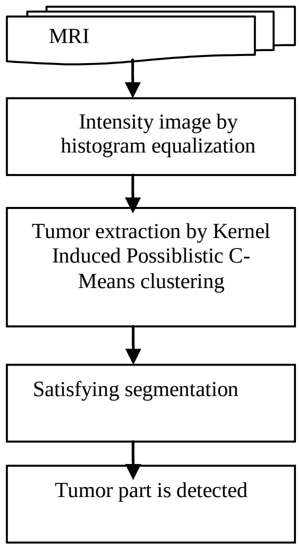


Fig1: Proposed method

A. Histogram Equalization

Histogram equalization is the technique by which the dynamic range of the histogram of an image is increased. Histogram equalization assigns the intensity values of pixels in the input image such that the output image contains a figure 4 show the uniform distribution of intensities (17). If the histogram of any image has many peaks and valleys, it will have peaks and valley after equalization, but peaks and valley will be shifted. Because of this, "spreading" is a better term than "flattening" to describe histogram equalization.

B. Algorithm of Kernel Induced Possiblistic C-Means Clustering

Kernel function is used to transform patterns into a higher dimensional feature space. The transformation of the feature space into higher dimensional space can allow the naturally distributed groupings of data to be partitioned more effectively. The key idea in kernel based clustering is that the transformation function need not be explicitly specified. The kernel function is defined as the dot product of two values obtained by the transforming function into input space. The summary of the algorithm is listed given below

Summary of KPCM Clustering Algorithm

Step:1
Initialization of memberships
Initialize fuzzier m, stopping criterion £, k=0;
Set initial uij(0) with memberships resulting from FKCM
Set initial σ^2 resulting from FKCM;

Step:2
Minimization of objective function
REPEAT k← k+1
Compute $d^2(x_i,v_j)$ using the equation

$$k(xk,xk) - 2\frac{\sum_{j=1}^{N} u_{ij}^{m}}{\sum_{j=1}^{n} u_{ij}^{m}} + \frac{\sum_{j=1}^{n}\sum_{i=1}^{n} u_{ij}^{m}}{\sum_{j=1}^{n} u_{n}^{m}}$$

Compute n_{ij} and $u_{ij}(k)$

UNTIL

$$\left\| u_{ij(k)-} u_{ij(k)-} \right\| <€$$

III. EXPERIMENTAL RESULT

The proposed segmentation technique have been implemented using Matlab 7.0.The performance of various brain tumor image is analyzed and each Magnetic Resonance image shows different location. The MSE, PSNR and SSIM are used to evaluate the segmentation of medical image (6). The result is given in Figure (1,2)

PSNR & MSE

The phrase peak signal- to-noise ratio, often abbreviated PSNR, is an engineering term for the ratio between the maximum possible power of a signal and power of corrupting noise that affects the fidelity of its representation. Because many signals have a very wide dynamic range, PSNR is usually expressed in terms of the log arithmetic decibel scale. To calculate PSNR value, use the following formula.

$$\text{PSNR}=10.\log_{10}\left(\frac{MAX_1^2}{\sqrt{MSE}}\right)$$

$$MSE = \frac{1}{mn}\sum_{i-1}^{m-1}\sum_{j=0}^{n-1}[I(i,j)-K(i,j)]2$$

It is most easily defined by means MSE where m×n is no of pixel in the image and I(i,j) is the input image K(i,j) is the output image.

SSIM

The structural similarity (SSIM) index is a method for measuring the similarity between two images. The SSIM index is a full reference metric, in other words, the measuring of image quality based on an initial uncompressed or distortion-free image as reference. SSIM is designed to improve on traditional methods like peak signal-to-noise ratio (PSNR) and mean squared error (MSE), which have proved to be inconsistent with human eye perception. The SSIM metric is calculated on various windows of an image. The measure between two windows x and y of common size N×N is:

$$SSIM(x,y) = \frac{(2\mu_x\mu_y + C_1)(2\sigma_{xy} + C_2)}{(\mu_x^2 + \mu_y^2 + C_1)(\sigma_x^2 + \sigma_y^2 + C_2)}$$

where μ_x is the average of x, μ_y is the average of y, $\sigma^2 x$ is variance of x, $\sigma^2 y$ is variance of y, σ_{xy} represents the covariance of x and y, $c1=(k_1 L)^2$, $c2=(k_2 L)^2$ two variables to stabilize the division with weak denominator, L represents the dynamic range of the pixel values and K_1 =0.01 and K_2 =0.03 by default. The set of pixel value of MSE,SSIM and PSNR is calculated of MRI images are tabulated below.

Table 1: PSNR, SSIM and RMSE values for different MRI

Methods	K-Means	Kernel Induced fuzzy Possiblistic Clustering algorithm
PSNR	118.45	104.34
MSE	45.12	57.23
SSIM	15.57	21.32

The extraction of brain tumor is represented figure2. Here tumor part is detected using Kernel Induced fuzzy Possiblistic algorithm were used and compare with parameters into K-Means clustering.

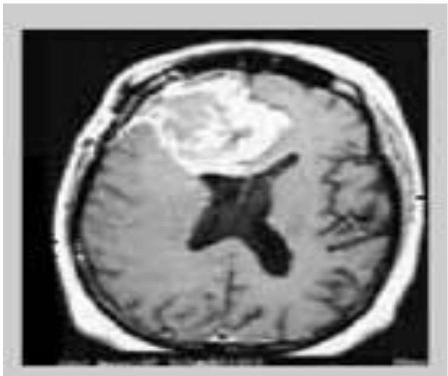
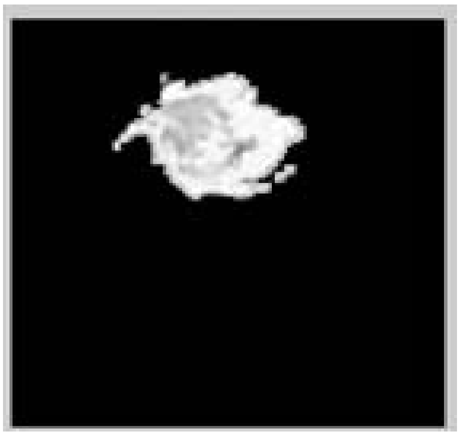


Fig 1: a) Original image



B) Tumor region

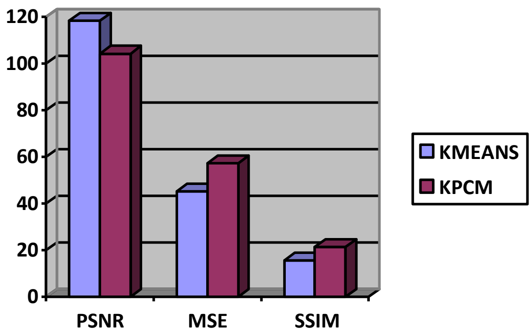


Fig-2 Result analysis of various parameters

IV.CONCLUSION AND FUTURE WORK

The accurate results of Kernel Induced Fuzzy C-means clustering algorithm effectively extract the tumor region from brain MRI brain images. Our proposed work was successful in detecting the tumor region extracted; hence this work can be extended for more abnormality condition in the brain. At last the statistical parameters are compared with K-Means clustering with our proposed work. Finally we conclude that Kernel Induced Fuzzy C-Means clustering algorithm is better.

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