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BRAIN TUMOR SEGMENTATION USING K-MEANS CLUSTERING AND FUZZY C-MEANS ALGORITHMS AND ITS AREA CALCULATION AND DISEASE PREDICTION

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Abstract - *This work deals with the implementation of Simple Algorithm for detection of range and shape of tumor in brain MR images and predicts the disease risk details from the given area of tumor. Tumor is an uncontrolled growth of tissues in any part of the body. Tumors are of different types and they have different Characteristics and different treatment. As it is known, brain tumor is inherently serious and life-threatening because of its character in the limited space of the intracranial cavity (space formed inside the skull).*

Most Research in developed countries show that the number of people who have brain tumors were died due to the fact of inaccurate detection. Generally, CT scan or MRI that is directed into intracranial cavity produces a complete image of brain. After researching a lot statistical analysis which is based on those people whose are affected in brain tumor some general Risk factors and Symptoms have been discovered. The development of technology in science day night tries to develop new methods of treatment. This image is visually examined by the physician for detection & diagnosis of brain tumor. However this method accurate determines the accurate of stage & size of tumor and also predicts the disease details from the area of tumor. This work uses segmentation of brain tumor based on the k-means and fuzzy c-means algorithms. This method allows the segmentation of tumor tissue with accuracy and reproducibility comparable to manual segmentation. In addition, it also reduces the time for analysis and predicts the disease details from the given area of tumor. Finally implement a system using java to predict Brain tumor risk level which is easier, cost reducible and time savable.

***Key Words*: Tumor, CT scan, MRI, k-means algorithms, Fuzzy -means algorithms**

I INTRODUCTION

The tumor may have various stages based on their cells. Normally brain tumor affects CSF (Cerebral Spinal Fluid). It may cause strokes. The physician gives the treatment for the diseases rather than the treatment for tumor. So detection of tumor is important for that treatment. The life of the person who is affected by the brain tumor will be saved if it is detected at current stage. Normally tumor cells are of two types. They are Mass and Malignant. The detection of the malignant tumor is somewhat difficult to mass tumor. In this research, the focus is on detection of brain tumor with the help of Brain MRI images and predicts the disease details from the given area of tumor.

Treatment for brain tumor depends on the type and stage of the disease, the size and place of the tumor, and your general health and medical history. In most cases, the goal of treatment is to remove or destroy the tumor completely. The tumor can be genetical disorder. Most brain tumor can be cured if found and treated early. This work deals with the concept for brain tumor segmentation and finally the detection of brain tumor and risk of disease. Treatment for brain tumor depends on the type and stage of the disease, the size and place of the tumor, and your general health and medical history. In most cases, the goal of treatment is to remove or destroy the tumor completely. Most brain tumor can be cured if found and treated early.

In this work, two algorithms are used for segmentation, K-means clustering algorithm and Fuzzy C algorithm. K-means is easy to compute and faster than any hierarchical clustering, depends upon the value of k. It can move or club one cluster to another. It is useful to compact cluster having strong co-relation between similar instant. However, it is difficult to identify the number of clusters and sensitive for measurement of data. The fuzzy-c means is robust against noise sensitivity which can overcome the coincident cluster and eliminates row constraints of fuzzy-c means.

To overcome, the prediction and detection of brain tumor, the clustering techniques are used and its comparison is studied with the help of various parameters.

II LITERATURE SURVEY

A. Lakshmi and Arivoli et. al (2012) has suggested a synergistic and an effective algorithm for the detection of brain tumors in based on Median filtering, K Means Segmentation, FCM Segmentation, and finally, threshold segmentation. The implemented method enhances the quality of the tumor images acquired by the aid of MRI and then to detect the size of the tumors, approximate Reasoning is applied. The propounded approach was tested with brain tumor images acquired by the help of MRI, thus precisely segmenting and detecting the brain tumor in the images.

Samir and Paul in have proposed a system of image registration and data fusion theory adapted for the segmentation of MR images. This system provides an efficient and fast way for diagnosis of the brain tumor called K-means algorithm. Implanting the K-mean algorithm which consists of multiple phases. First phase consists of registration of multiple MR images of the brain taken along adjacent layers of brain. In [2], these registered images are fused to produce high quality image for the segmentation. Finally, segmentation is done by improved K -means algorithm with dual localization methodology. This system provides an efficient and fast way for diagnosis of the brain tumor called K-means algorithm.

Meena and Raja proposed an approach of Spatial Fuzzy C means (PET-SFCM) clustering algorithm on Positron Emission Tomography (PET) scan image datasets. The proposed FCM successful able to join the spatial neighborhood information with classical FCM and updating the objective function of each cluster. However in [3] it exploits the segmentation which used for quick bird view for any problem of K-means. This system algorithm is implemented and tested on huge data collection of patients with brain neuro degenerative disorder such as Alzheimer's disease.

Fazel and Izadi explains in [6] the field of pattern recognition due to the fundamental involvement of human perception and inadequacy of standard Mathematics to deal with its complex and ambiguously defined system, different fuzzy techniques have been applied as an appropriate alternative. The proposed fuzzy c-means technique Euclidean distance has been used to obtain the membership values of the objects in different clusters; in our present work along with Euclidean distance we have used other distances like Canberra distance, Hamming distance to see the differences in outputs. The proposed Type-II fuzzy image processing method has four distinct modules: Pre-processing, Segmentation, Feature Extraction, and Approximate Reasoning. We develop a fuzzy rule base by aggregating the existing filtering methods for Pre-processing step. For Segmentation step, we extend the Possibilistic C-Mean (PCM) method by using the Type-II fuzzy concepts, Mahalanobis distance, and Kwon validity index. Feature Extraction is done by Thresholding method.

J. Selvakumar and Arivoli et. al in (2012), a person who was affected by any kind of tumor has an increased risk of developing another brain tumor of any type in [1]. A person who has two or more close relatives (mother, father, sister, brother, or child) who are responsible for developing brain tumor has a risk factor of developing brain tumor for his own. Rarely, members of a family will have an inherited disorder that makes the brain more sensitive and increases the risk of brain tumor. About 5% of brain tumors may be linked to hereditary (genetic) factors or conditions.

Wilson and Dhas (2014), used K-means and Fuzzy C-means in [10] respectively to detect the iron in brain using SWI technique. Susceptibility-weighted imaging (SWI) is a neuro imaging technique, which uses tissue magnetic susceptibility differences to generate a unique contrast. The extraction of the iron region in the brain is made by K-means and Fuzzy C-means clustering method. This works helps in the clinical diagnosis of brain iron in SWI images. This decision can assist as a supportive aid which can be used at the doctor's discretion in finally declaring a decision.

Beshiba (2014), explains analytical performance of k- means and fuzzy c means used for segmentation of brain images. However, in [8] the description of area calculation of segmented brain is explained using k-means.

III PROBLEM STATEMENT

There are some algorithms like thresholding method, region growing, using only k-means algorithm but all these algorithm are not able to extract all fine spatial characteristics of MRI image. Thus there is a problem with these algorithms as they are not successfully detecting the brain tumor in the image. Brain tumor is a disease of the brain in which tumor cells (malignant) arise in the brain tissue. Tumor cells grow to form a mass of tumor tissue that interferes with brain functions such as muscle control, sensation, memory, and other normal body functions. The size of tumor and calculate the area of tumor and with the help of tumor size conclude the stage of tumor. Brain Tumor Segmentation Using K-Means Clustering and Fuzzy C-Means Algorithms and its Area Calculation and Disease Prediction

IV PROPOSE SYSTEM

A. K-means clustering

K-Means is the one of the unsupervised learning algorithm for clusters. Clustering the image is grouping the pixels according to the same characteristics. In the k-means algorithm initially we have to define the number of clusters k. Then k-cluster center are chosen randomly. The distance between the each pixel to each cluster centers are calculated. The distance may be of simple Euclidean function. Single pixel is compared to all cluster centers using the distance formula. 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 center converges. K-Means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. The fact that they both have the letter K in their name is a coincidence. K-means is a clustering algorithm that tries to partition a set of points into K sets (clusters) such that the points in each cluster tend to be near each other. It is unsupervised because the points have no external classification. K-means clustering is a clustering algorithm that aims to partition n observations into k clusters.

Mathematical equation in K-means clustering:

For a given image, compute the cluster means m

1., k=1, 2,……, K.

Calculate the distance between the cluster centers to each pixel

2. D (i) = arg min||X i - M k || 2, i=1, 2,… N.

Repeat the above two steps until mean value convergence.

Algorithm:

1. Give the no of cluster value as k.
2. Randomly choose the k cluster centers
3. Calculate mean or center of the cluster
4. Calculate the distance b/w each pixel to each cluster center
5. If the distance is near to the center then move to that cluster.
6. Otherwise move to next cluster.
7. Re-estimate the center.
8. Repeat the process until the center doesn't move.

B. Fuzzy C-Means Algorithm

The Fuzzy C-means is an unsupervised clustering algorithm which can be applied to several problems involving feature analysis, clustering, medical diagnosis and image segmentation. Fuzzy C-means clustering (FCM) algorithm was proposed by Bezdek et.al in which each data point belongs to a cluster to a degree specified by a membership grade. The FCM algorithm minimizes the objective function for the partition of data set, x = [x1, x2, ..., xd]T .Fuzzy C-means is one of the commonly used and efficient objective function-which is based on clustering techniques. Data clustering or cluster analysis is an important field in pattern recognition, machine intelligence and computer vision community, that has had numerous applications in the last three decades

Step 1: Initialization

-Scan the image line by line to construct the vector X containing all the gray level of the image

-Randomly initialize the centers of the classes vector V (0).

From the iteration t=1 to the end of the algorithm:

Step 2: Calculate the membership matrix $U^{(t)}$ of element u_{ik}.

Step 3: Calculate the vector $V^{(t)} = [v_1, v_2, ..., v_c]$.

Step 4: Convergence test: if $\|V^{(t)} - V^{(t-1)}\| > \varepsilon$, then increment the iteration t, and return the Step 2, otherwise, stop the algorithm. ε is a chosen positive threshold.

Approximate reasoning

In the approximate reasoning step the tumor area is calculated using the binarization / thresholding method.

And also identify the stage of tumor. That is the output

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image having only two values either black or white (0 or 1).
So,
Calculate the area of tumor=
Area= $\sqrt{P} * 0.264$
Where, p= total no of white pixels of threshold image.
And 0.264 is the 1 pixel size.
5. Naive-Bayes Classification:
In is step classify to predict the disease details from the given area of tumor.

V MATHEMATICAL MODEL

Mathematical equation in K-means clustering

1. $M = \frac{\sum_{i:c(i)=k} Xi}{Nk}$, k=1, 2,……, K.

2. $D(i) = \arg\min \|X_i - M_k\|^2$, i=1, 2,….., N.

Mathematical equation in Fuzzy-C means clustering

$$Y_m = \sum_{i=1}^{N} \sum_{j=1}^{C} M_{ij}^{m} \|X_i - C_j\|^2$$

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 center of the cluster,
The update of membership Mij and the cluster centers R are given by:

$$M_{ij} = \frac{1}{\sum_{K=1}^{C} \left(\frac{\|Xi - Cj\|}{\|Xi - Cj\|}\right)^{\frac{2}{m-1}}}$$

$$R_j = \frac{\sum_{i=1}^{N} Xi.Mijm}{\sum_{i=1}^{N} Mijm}$$

Let consider S is a system for Brain Tumor Segmentation Using K-Means clustering and Fuzzy C-Means techniques
and Its Area Calculation and Disease Prediction Using Naive-Bayes technique.
S= {….}
INPUT:
Identify the inputs
F= {f1, f2, f3 ....., fn| 'F' as set of functions to execute commands.}
I= {i1, i2, i3…|'I' sets of inputs to the function set}
O= {o1, o2, o3….|'O' Set of outputs from the function sets}
S= {I, F, O}
I = {Query submitted by the user}
O = {Output of desired query}
F = {Functions implemented to get the output,
K-means clustering,
Fuzzy C –means clustering, Naive-Bayes Algorithm}

SPACE COMPLEXITY

The space complexity depends on Presentation and visualization of discovered patterns. More the storage of data more is the space complexity.

TIME COMPLEXITY

Check No. of patterns available in the datasets= n
If (n>1) then retrieving of information can be time consuming.
So the time complexity of this algorithm is O(n^n).
ϕ= Failures and Success conditions.

Failures:

Huge database can lead to more time consumption to get the information.
Hardware failure.
Software failure.

Success:
Search the required information from available in Datasets.
User gets result very fast according to their needs.
If size is less than 17 mm then it is in initial stage
And more than it is a secondary stage

VI RESULTS

There are some algorithms like thresholding method, region growing, using only k-means algorithm but these entire al

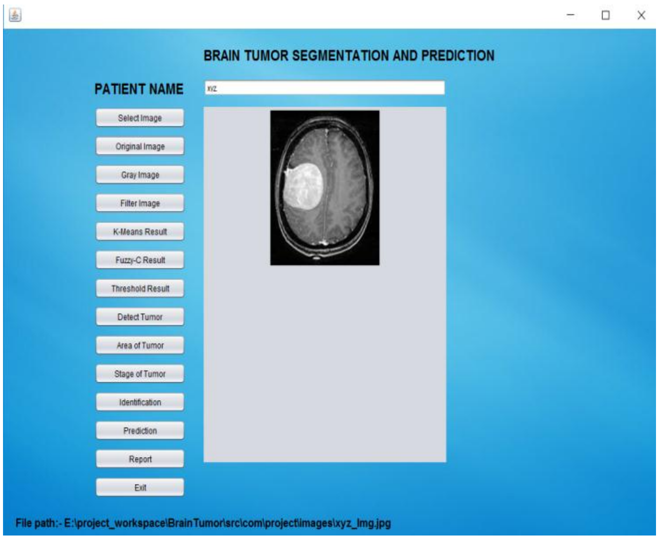

Figure 1: GUI of Brain Tumor Detection application

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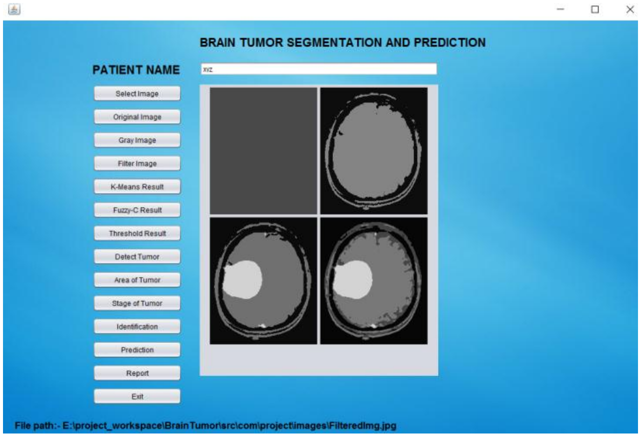

Figure 2: Results of k-means image

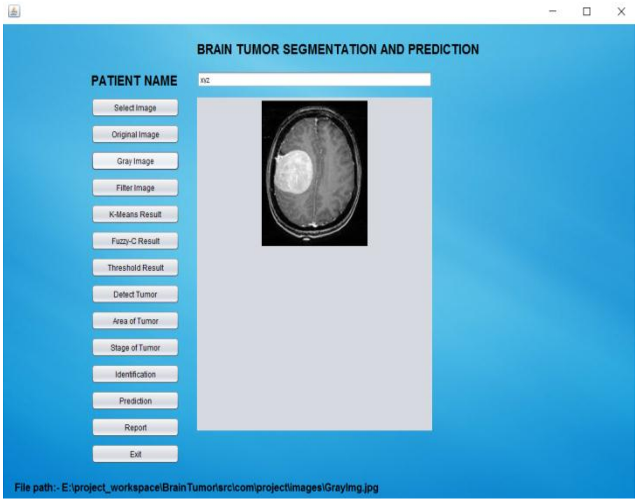

Figure 3: Gray Image

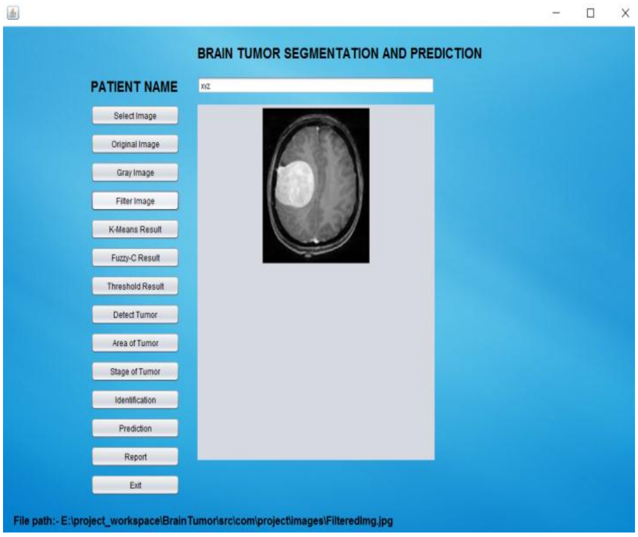

Figure 4: Filtered Image

VII GRAPH

Fig. 5 shows the segmentation accuracy of K-Means approach and Fuzzy C means approach using MRI scan brain images. So our work gives the better accuracy as compared to existing work.

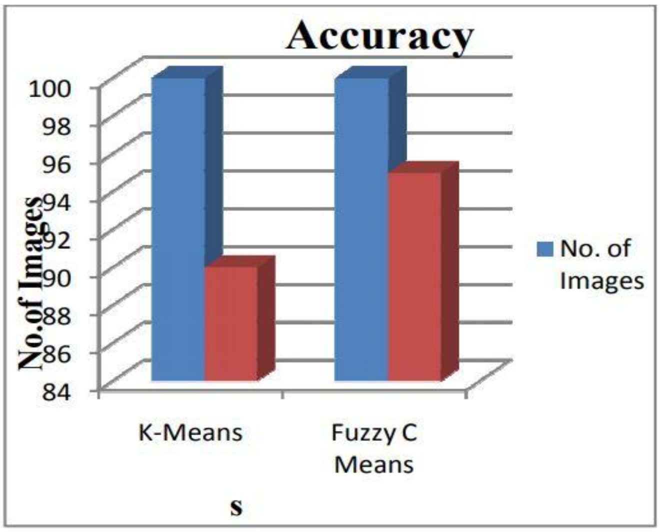

Figure 5. Accuracy Graph

Table: Brain Image Clustering Accuracy

	No. of images	Clustering Accuracy
k-mean	**100**	**99%**
Fuzzy C Means	**100**	**95%**

VIII CONCLUSIONS

- There are different types of tumors are available. They may be as mass in brain or malignant over the brain.
- Suppose if it is a mass then K- means algorithm is enough to extract it from the brain cells. If there is any noise are present in the MR image it is removed before the K-means process.
- The noise free image is given as an input to the k-means and tumor is extracted from the MRI image and then segmentation using Fuzzy C means for accurate tumor shape extraction of tumor and thresholding of output in feature extraction.
- In approximate reasoning for calculating tumor shape and position calculation.
- Finally predict the disease risk from resultant area of tumor. I.e. predict Brain tumor risk level which is easier, cost reducible and time savable.
- The experimental results are compared with other algorithms. The proposed method gives more accurate result.

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