IMPROVED BRAIN TUMOR SEGMENTATION AND DETECTION USING EM AND FCM ALGORITHM

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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 identifies stage of tumor from the given area of tumor. Tumor is an uncontrolled development of tissues in any piece of the body. Tumors are of various sorts and they have various Characteristics and diverse treatment.As it is known, brain tumor is characteristically genuine and dangerous attributable to its person in the constrained space of the intracranial cavity (area shaped inside the skull). Most Research in developed countries show that the number of people who have brain tumors were died because of the reality of inaccurate detection. Generally, CT test or MRI that is directed into intracranial hollow space produces a complete photocopy of brain. After researching a lot statistical analysis which is primarily based on those human beings whose are affected in brain tumor some general Risk factors and Symptoms had been discovered. The improvement 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 Expectation max-imization and fuzzy c-means algorithms. This method allows the segmentation of tumor tissue with accuracy and reproducibility comparable to manual segmentation. In addition, it additionally reduces the time for analysis and predicts the disease details from the given area of tumor.**

***Index Terms*—Deep Learning, Machine Learning, Medical image segmentation, Expectation Maximization, fuzzy c means clustering;**

I. INTRODUCTION

A. BACKGROUND

Deep learning concept is a subset of machine learning. It is a machine learning concept and functions in a similar way, but its abilities are different. Deep learning is a specially of machine learning concept that ac hive great power and insensibility by learning to display the world as nested order Of concepts, with each idea defined in relation to easy concepts, and greater abstract representations measure in terms of much less abstract ones.

Magnetic resonance imaging (MRI) is an effective approach to diagnose disease, by means of which the doctor can intuitively take a look at a patient's body structure and efficiently analyze the possibility of illness. However, each patient have hundreds of medical images, so it is a great dare to process and analyze the large amount of medical image data. Therefore, creative health care is an important research direction to help doctors in control medical big data. Especially, it is difficult to find the images containing nodules, which should be analyzed for helping early brain cancer diagnosis, from a large number of MRI scan images.

In this work, here two techniques are used for segmentation, EM clustering algorithm and Fuzzy C Clustering algorithm . So this technique offers the accurate and clear result for brain tumor detection and segmentation from MRI images. Tumor is because of the uncontrolled development of the tissues in any part of the human body. The tumor may be primary or secondary. If it is a basis, then it is known as primary. If the a part of the tumor is extend to another region and build as its own then it is referred to as secondary. The specialist gives the treatment for tumor. So detection of tumor is very important for that further future treatment. The life of the patient who affected by the brain tumor will grow if it is detected at current stage. That will grow the lifetime about 1 to 2 years. Normally the brain tumor cells are of two kinds specially that are Mass and Malignant. The detection of the malignant brain tumor is most hard to mass tumor because it could be unfold of the tissues in any a part of the human body. In this proposed system we build an application on detection of brain tumor with the help of Brain MRI images and predict the disease information from the given area of tumor.

B. MOTIVATION

A reliable method for segmenting tumor would clearly be a useful tool. Currently, however, there is no method widely accepted in clinical practice for quantitating tumor volumes from MR images. With the help of MR images can also to calculate the size of a brain tumor as it responds to future

treatment.

C. OBJECTIVES

1. To study machine learning of medical image analysis.
2. To detect the brain tumor in MRI image
3. To calculate the area of brain tumor
4. To Identify the stage of tumor.
5. To Predict the accurate disease from the given area of tumor

II. REVIEW OF LITERATURE

J.selvakumar, A.Lakshmi and T.Arivoli, "Brain Tumor Segmentation and Its Area Calculation in Brain MR Images using K-Mean Clustering and Fuzzy C-Mean Algorithm"
In this paper, 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 the second phase, 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. [1]

Samir Kumar Bandhyopadhyay and Tuhin Utsab Paul, "Automatic Segmentation of Brain Tumor from Multiple Images of Brain MRI"
In this project, we look at three algorithms namely K Means clustering, Expectation Maximization and the Normalized cuts and compare them for image Segmentation. The segmentation technique addresses the problem of segmenting an image into different regions. So the we can analyze both k-mean and C-mean algorithm in easy way [2].

A. Meena, "Spatial Fuzzy C-Means PET Image Segmentation of Neurodegenerative Disorder", 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. It exploits the segmentation which used for quick bird view for any problem of K-means. [3]

Suman Tatirajua and Avi Mehta, "Avoiding energy holes in wireless sensor networks with nonuniform node distribution,"
In this paper proposed k-means and C-mean to extract the features from the images. K-Means and Fuzzy C- Means In this process the tumor is extracted from the MR image and its exact position and the shape also determined. The stage of the tumor is displayed based on the amount of area calculated from the cluster. [4]

Ajala Funmilola A, Oke O.A, Adedeji T.O and Alade O.M, Adewusi E.A, "Fuzzy k-c-means Clustering Algorithm for Medical Image Segmentation",
Funmilola et al proposed the Fuzzy K-C-means method, which carries more of Fuzzy C-means properties than that of K-means. The F-K-C means focused attention on Clustering methods. These k-mean and C-mean algorithms were combined together to come up with another method called fuzzy k-c-means clustering algorithm, which has a better result in terms of time utilization. [5]

Beshiba Wilson and Julia Punitha Malar Dhas, " An Experimental Analysis of Fuzzy C-Means and K-Means Segmentation Algorithm for Iron Detection in Brain SWI using Matlab",
Wilson and Dhas used K-means and Fuzzy C-means 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. [6]

M.H. Fazel Zarandia, M. Zarinbal and M. Izadi, "Systematic image processing for diagnosing brain tumors",
This paper proposed a dip study of brain tumor. It describes different form of analysis approaches.A brief expertise about tumor like glial tumor which cover 30% of all brain tumors. [7]

Samarjit Das, "Pattern Recognition using the Fuzzy c-means Technique"
In the sphere of pattern recognition because of the fundamental involvement of human perception and inadequacy of standard Mathematics to deal with its complicated and ambiguously described system, different fuzzy techniques had been applied as the suitable opportunity The proposed fuzzy c-mean method Euclidean distance has been used to achieve the membership values of the objects in different clusters; in the authors work at the side of Euclidean distance they've used other distances like Canberra distance, Hamming distance to peer the differences in outputs. [8]

Vignesh Rajesh, Bharathan Venkat, Vikesh Karan and M. Poonkodi, "Brain Tumor Segmentation and its Area Calculation in Brain MR Images Using K-Mean Clustering and Fuzzy C-Mean Algorithm",
This paper has suggested a synergistic and an effective algorithm for the detection of brain tumors based on Median filtering, K Means Segmentation, FCM Segmentation. The implemented methods enhance 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. [9]

Krishna Kant Singh1 and Akansha Singh, "A Study of Image Segmentation Algorithms For Different Types Of Images",
In this paper the author offers a study of the various algorithms that are available for colour images, text and gray scale images.Implementation of segmentation technique those are shade-based segmentation, pixel- based segmentation and edge-based segmentation. [10]

Miss. Shrutika Santosh Hunnur, Akshata Raut, Swati Kulkarni," Implementation of image processing for detection of brain tumor",
The paper is proposed by processing of magnetic resonance image (MRI) is one among the parts of the image processing in medical field and describes the detection of brain tumor by thresholding method. [11]

Priyanka S. Jadhav, Meeta Bakuli, "Brain tumor detection using MRI image processing",
This paper is proposed by MRI technique. This MRI is used for taken on brain tumor image in separated and collected for more information of brain tumor. [12]

III. PROPOSED METHODOLOGY

This approach is based on deep learning so we work on MRI scan medical images of human brain using Expectation Maximization clustering and fuzzy c means clustering techniques.

First, image pre-processing step, we check the presence of noise in input medical (magnetic resonance imaging) image. If the noise is present in given image then we removed this noise using median filter technique. To remove the noise from image for further processing, we use median filter technique.

After that additionally, the image segmentation is carried out by using Expectation-Maximization and Fuzzy C-means techniques. Then the feature are extracted by using image thresholding and finally, approximate reasoning step to recognize the tumor area and stage in MRI image and also predict the disease risk from result area of brain tumor.

Advantages of Proposed System:

1. This system will use median filter for noise removal so will get accurate clear image.
2. This work on deep learning using Expectation maximization clustering and fuzzy c means clustering.
3. It consist two algorithms for clustering which effectively able to extract tumor from image and gives the actual final result.
4. This proposed system effectively able to extract all the spatial characteristics of an Image.
5. This proposed system accurately calculate the brain tumor area and stage of an Image.

A. Architecture

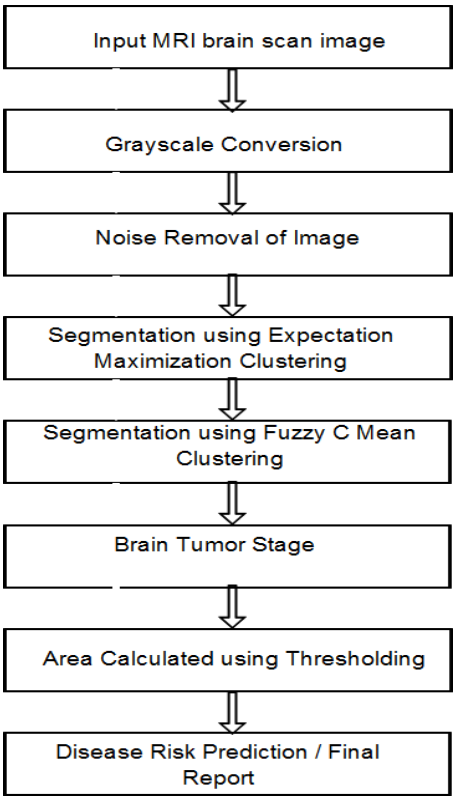

Fig. 1. Proposed System Architecture

Explanation:
Image Pre-processing

In this step here, we used median filter for brain image noise removal. The possibilities of present of noise in modern MRI scan are very less. It may present due to the thermal effect. The main aim of this work is to detect and segment the tumor cells in image. But for the complete system it needs the process of noise removal.But for the complete system it desires the manner of noise removal.

Segmentation using Expectation-Maximization
Steps:

1) Give the number of cluster value as k.
2) Then randomly select the k cluster centers
3) After that calculate the mean or center of the cluster

4) Also calculate the distance between each pixel to each cluster center
5) If this distance is near to the cluster center then move to that cluster.
6) Otherwise move to next cluster.
7) Re-estimate the cluster center.
8) Repeat the process until the cluster center doesn't move.

Segmentation using Fuzzy C means

The fuzzy logic is a method to processing the data by giving the partial membership value to each pixel in the image.

The membership method value of the fuzzy set is ranges from 0 to 1. Fuzzy C Means clustering is originally a multi valued logic that allows middle values i.e., member of one fuzzy set can also be member of other fuzzy sets in the same image.

There is no suddenly transition between full membership and non-membership.

The membership method defines the fuzziness of an image and also to define the information contained in the image.

Approximate reasoning

In the approximate reasoning step, the brain tumor area is calculated using the image thresholding method. That is the threshold image having only two values either black value or white value (0 or 1). And then classify the stage of tumor from the given area of tumor.

B. Algorithms

1. Expectation-Maximization:

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 minimum distance among all. Then the centroid is re-calculated. Again each pixel is compared to all centroids. The procedure nonstop until the point that the middle merges.

2. Fuzzy C-Means Algorithm:

The Fuzzy C-means is an unsupervised clustering technique (deep learning) which can be applied to several issues involving feature analysis, clustering, medical diagnosis and image segmentation. Fuzzy C-means clustering (FCM) technique was proposed by Bezdek et.al in which each data point related to a cluster to a degree described by a membership grade. The FCM technique make smaller the objective function for the division of data set, x = $[x1, x2, \ldots, xd]^T$

C. Mathematical Model

1. Mathematical equation in Expectation-Maximization

$$\sum_{k^{x_i}}$$

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

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

2. Mathematical equation in Fuzzy-C means clustering:

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

Where,

m= any real number greater than 1,

M_{ij}= degree of membership of X; in the cluster j,

X_i= data measured in d-dimensional, R_j= d-dimension center of the cluster, The update of membership M_{ij} and the cluster centers R are given by:

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

$$\sum$$

clustering:

$$X_i M_{ij}\ m$$

$$R_{ij} = \frac{i=1}{\sum M_{ij}\ m}$$

$$i=1$$

IV. RESULT AND DISCUSSION

Experiments are done by a personal computer with a configuration: Intel (R) Core (TM) i5-6700HQ CPU @ 2.60GHz, 16GB memory, Windows 7, MySQl Server 5.1 and Jdk 1.8. In our system, we upload the MRI image as an input and apply median filter for filtering noise from the give image. Then our system applies the three algorithms mentioned above. Finally we will detected the tumor in the input image.

Detection between Algorithms:

S.No	Algorithm	No.of MRI Images	Detected Samples	Rate of Accu-racy
01	Proposed Sys-tem	25	22	89%
02	Existing Sys-tem	23	19	83%

V. CONCLUSION

Brain Tumor segmentation is carried out in this supplied work. Firstly MRI image pre-processing is done the usage of median filter technique. If there is any noise are present inside the MR image it is removed using Gaussian filter technique. The noise free input MRI image is given as an input to the fuzzy C mean algorithm and tumor is extracted from the MRI image. And then segmentation the usage of expectation–maximization (EM) algorithm for accurate tumor shape extraction of malignant tumor and thresholding of output in feature extraction. Finally approximate reasoning step for calculating tumor area and position calculation and at the end

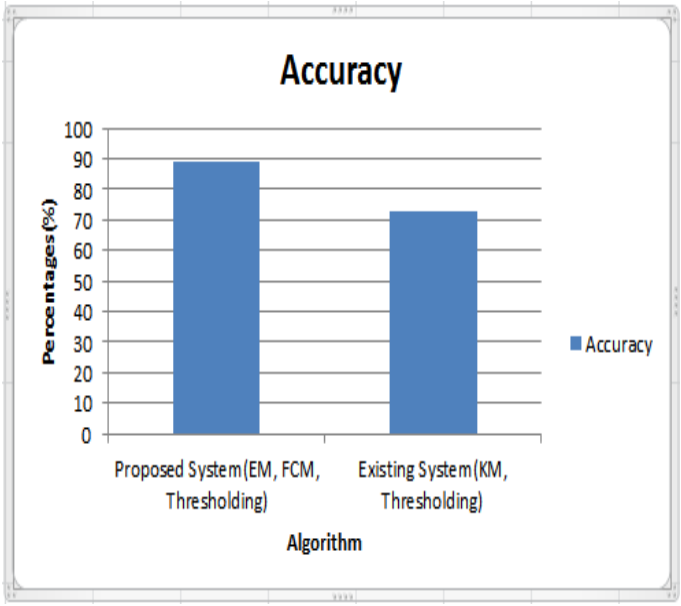

Fig. 2. Comparison graph

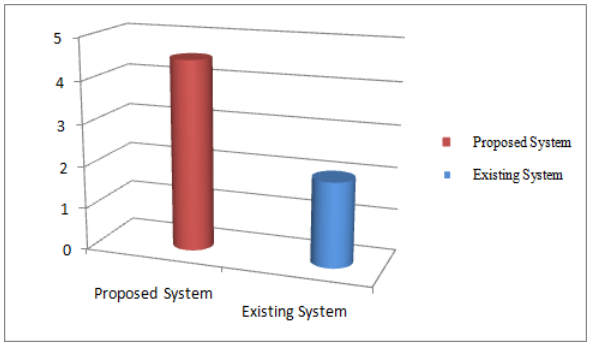

Fig. 3. Algorithms Comparison graph

to indentify stage of tumor from resultant area of tumor i.e. Identifies stage of tumor that is easier, cost reducible and time savable.

ACKNOWLEDGMENT

The authors would like to thank the researchers as well as publishers for making their resources available and teachers for their guidance. We are thankful to the authorities of Savitribai Phule University of Pune and concern members of CPGCON 2020 conference, organized by, for their constant guidelines and support. We are also thankful to the reviewer for their valuable suggestions. We also thank the college authorities for providing the required infrastructure and support. Finally, we would like to extend a heartfelt gratitude to friends and family members.

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