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# Brain Tumor Identification using MRI Images

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***Abstract*—** In this paper, we propose segmentation method that uses the K-means clustering technique to identify the tumor in magnetic resonance image (MRI). Brain image segmentation is one of the most important parts of clinical diagnostic tools. Brain images mostly contain noise, inhomogeneity and sometimes deviation. So in this paper K-means clustering algorithm is to convert a given RGB image into a gray scale image and then separate the position of tumor objects. This improves the tumor boundaries accurately and is less time consuming when compared to many other clustering algorithms. In the conformal radiotherapy, the tumor cells are irradiated and killed with a very high precision, avoiding damage to the neighboring healthy tissues. The main objective of this study is the design of a computer system able to detect the presence of digital images of the brain and to accurately define its borderlines.

***Keywords****-Image Segmentation, MRI, K-means clustering, Morphological filtering*.

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## I. INTRODUCTION

Image Processing is a method to convert an image into digital form & perform some operation on it, in order to get an enhanced images or to extract some useful information from it. All the images used in today's world are in the digital format. Medical Imaging is the techniques, process & art of creating visual representation of the interior of the body for clinical analysis and medical intervention. In MRI, CT scans are performed to analyze the internal structure of various parts of human body which helps doctors to visualize the inner portion of the body. CT scanner, ultrasound, MRI took over conventional X-ray imaging, by allowing the doctors to see the body's third dimension. According to International Agency for Research on Cancer (IARC) approximately, more than 126000 people are diagnosed for brain tumor per year around the world, with more than 97000mortality rate. This paper presents a review of the methods and techniques used during brain tumor detection through MRI image segmentation and we have proposed segmentation of brain MRI image using K-means clustering algorithm followed by morphological filtering.

The basic concept is that local textures in the images can reveal the typical regularities of the biological structures. Thus, the textural features have been extracted using a co-occurrence matrix approach. The level of recognition, among three possible types of image areas: tumor, non-tumor and back ground. We are into tumor image segmentation.[1]

Generally, human brain includes three major parts controls different activity. [2]

### *A. Cerebrum*

The cerebrum controls learning, thinking, emotions, speech, problem solving, reading and writing. It is divided into right and left cerebral hemispheres. Muscles of left side of the body control by right cerebral hemispheres and muscles of right side of the body control by left cerebral hemispheres.

### *B. Cerebellum*

The cerebellum controls movement, standing, balance and complex actions.

### *C. Brain stem*

Brain stem joints the brain with spinal cord. Brain stem controls blood pressure, body temperature and breathing and controls some basic functions.

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3050 – 3054

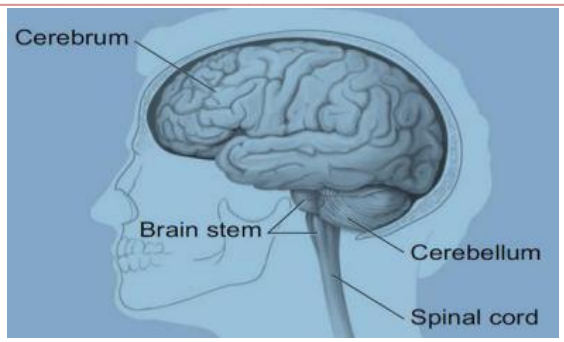


Fig. : Structure of Brain

## II. RELATED WORK

### *A. Magnetic resonance imaging (MRI)*

A magnetic resonance imaging (MRI) scanner uses powerful magnets to polarise and excite hydrogen nuclei (single proton) in human tissue, which produces a signal that can be detected and it is encoded spatially, resulting in images of the body. MRI is a technique that can changes in the blood properties as they related to brain activity. MRI has also proven valuable in the surgical treatment of brain by allowing regions with essential brain functions to be located. The surgeon can avoid damaging this regions while removing as much diseases or dysfunctional tissue as possible.[3]

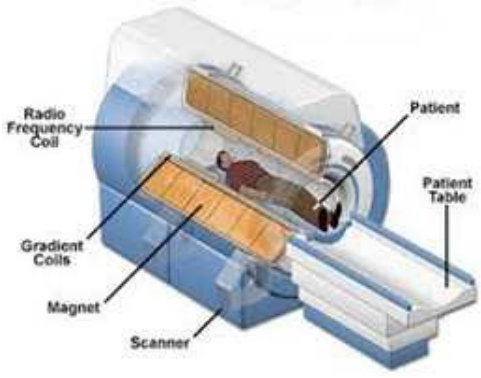


Fig : MRI Scanner

### *B. Challenges*

The brain is the anterior most part of the central nervous system. Brain tumor is an intracranial solid neoplasm. Tumors are created by an abnormal and uncontrolled cell division in the brain. In this work, we have used axial view of the brain image (2D) from MRI scan because MRI scan is less harmful than CT brain scan. A patient is subjected to different diagnostic methods to determine the cause of the symptoms mentioned by him. [4]

### *C. Partitioning Method*

A partitioning methods are divided into two subcategories, one is centroid and other is medoids algorithms. Centroid algorithms represent each cluster by using the gravity centre of the instances. The medoid algorithms represents each cluster by means of the instances closest to gravity centre. The well-known centroid algorithm is the k-means. The k-means method partitions the data set into k subsets such that all points in a given subset are closest to the same centre. In detail, it randomly selects k of the instances to represent the clusters. Based up on the selected attributes, the remaining instances are assigned to their closer centers. K-means then computes the new centers by taking the mean of all data points belonging to the same cluster. The process is iterated until there is no change in the gravity centers. If k cannot be known ahead of time, various values of k can be evaluated until the most suitable is found. The effectiveness of this method as well as of others relies heavily on the objective function used in measuring the distance between instances.

**Disadvantages:**

1. They tend to be computationally more expensive.
2. over fitting-This problem might be caused by two reasons. one hand, a large number of clusters maybe specified. And on the other, the distributions of probabilities have too many parameters. In this process, one possible solution is to adopt a fully Bayesian approach, in which every parameter has a prior probability distribution.

*K-means clustering*

K-means is often called ‘Lloyd algorithm’ in computer science and engineering is used in vector quantization for compression. Basic idea: run K-means clustering on 4*4 squares of pixels in an image and keep only the clusters and labels, smaller k means more compression. In statistics and machine learning, *k*-means clustering is a method of cluster analysis which aims to partition observations into *k* clusters in which each observation belongs to the cluster with the nearest mean. It is similar to the expectation-maximization algorithm for mixtures of Gaussians in that they both attempt to find the centers of natural clusters in the data. The *k*-means clustering algorithm is commonly used in computer vision as a form of image segmentation. The results of the segmentation are used to aid border detection and object recognition. In this context, the standard Euclidean distance is usually insufficient in forming the clusters. Instead, a weighted distance measure utilizing pixel coordinates, RGB pixel color and/or intensity, and image texture is commonly used.

The general reason for selecting these algorithm are popularity,flexibility,applicability, handling high dimensionality.

**Advantages:**

1. Simplest, reduce place, work on large database.
2. If variables are huge, then K-means most of the times computationally faster than hierarchical clustering, if we keep k small.

3. K-means produce tighter clusters than hierarchical clustering, especially if the clusters are globular.

**Disadvantages:**

1. Difficult to predict k-value.
2. With global cluster, it didn't work well.
1. 3.Different initial partitions can result in different final clusters.
3. If does not work well with clusters (in the original data) of different size and different density.

**Application:**

1. Easy to implement and apply even on large database.
2. High performance, high availability.
3. Improve throughputs & scalability over single instance system and improve response time.
4. Transparency.

## III. LITERATURE REVIEW

Comparative study of different segmentation techniques is summarized with advantages and disadvantages. Most of the key features of methods are mentioned below with respective limitations and benefits that make our work unique.

a) In "Segmentation of Brain MRI through Hidden Markov Random Field Model and the Expectation- Maximization algorithm" paper.
**PROPOSED TECHNIQUE: Segmentation.**
ALGORITHM USED: Expectation maximization.
BENEFITS: Technique possesses ability to encode both spatial and statistical properties of an image.
IDENTIFIED PROBLEMS: The method requires estimating threshold and does not produce accurate results most of the time. [5]

b) In "A modified fuzzy c-means algorithm for bias field estimation and segmentation of MRI data" paper.
**PROPOSED TECHNIQUE: Bias Field Estimation**
ALGORITHM USED: Modified fuzzy C-means
BENEFITS: Faster to generate results
IDENTIFIED PROBLEMS: Technique is limited to a single feature input. [4]

c) In "MR-Brain Image Segmentation Using Gaussian Multi resolution Analysis and the EM Algorithm" paper.
**PROPOSED TECHNIQUE: Gaussian Multi Resolution Analysis.**
ALGORITHM USED: Expectation Maximization.
BENEFITS: Less sensitive to noise.
IDENTIFIED PROBLEMS: Rarely preserve edges.

d) In "Segmentation of MR Images of the Human brain using Fuzzy Adaptive Radial Basis function Neural Network" paper.
**PROPOSED TECHNIQUE: Neural Network**
ALGORITHM USED: Fuzzy adaptive era dial basis function
BENEFITS: It preserves sharpness of image.
IDENTIFIED PROBLEMS: Able to do only one task related to fusion

e) In "Three-level Image Segmentation Based on Maximum Fuzzy Partition Entropy of 2-D Histogram and Quantum Genetic Algorithm" paper.
**PROPOSED TECHNIQUE: Fuzzy Partition Entropy Of 2d Histogram And Genetic Algorithm.**
ALGORITHMs USED: QGA.
BENEFITS: QGA is selected for optimal combination of parameters.
IDENTIFIED PROBLEMS: Practically impossible.

f) In "A Texture based Tumor detection and automatic Segmentation using Seeded Region Growing Method" paper.
**PROPOSED TECHNIQUE: Texture Based Tumor Detection And Automatic Segmentation**.
ALGORITHM USED: Seeded Region growing.
BENEFITS: This is region growing segmentation method for segmentation of brain tumor in MRI, in which it is possible to determine abnormality is present in the image or not.
IDENTIFIED PROBLEMS: It takes more time.

g) In "Detection and Quantification of Brain Tumor from MRI of Brain and it's Symmetric Analysis" paper.
**PROPOSED TECHNIQUE: Modular Approach To Solve MRI Segmentation.**
ALGORITHM USED: Symmetry analysis.
BENEFITS: The proposed approach can be able to find the status of increase in the disease using quantitative analysis.
IDENTIFIED PROBLEMS: Time consuming.

h) In "Brain Tumor Identification in MRI with BPN Classifier and Orthonormal Operators" paper.
**PROPOSED TECHNIQUE: Brain Tumor Identification In MRI With BPN Classifier And Orthonormal Operators.**
ALGORITHM USED: K-means clustering, BPN classifier.
BENEFITS: Combines clustering and classification algorithm.
IDENTIFIED PROBLEMS: Accuracy can be improved in less time[6].

## IV. PROPOSED WORK

Proposed Algorithm: K-means Clustering
Step 1: The initial partitions are chosen by getting the R, G, B values of the pixels.
Step 2: Every pixel in the input image is compared against the initial partitions using the Euclidian Distance and the nearest partition is chosen and recorded.

Step 3: Then, the mean in terms of RGB color of all pixels within a given partition is determined. This mean is then used as the new value for the given partition.

Step 4: Once the new partition values have been determined, the algorithm returns to assigning each pixel to the nearest partition. Performance Analysis of Clustering Algorithms in Brain Tumor Detection of MR Images 324

Step 5: The algorithm continues until pixels are no longer changing which partition they are associated with or until none of the partition values changes by more than a set small amount.

$$J(W_{qk}, Z^{(k)}) = \sum_{k=1}^{k} \sum_{k=1}^{k} (w_{qk}) \left\| X^{(q)} - Z^{(k)} \right\|^2$$

We have proposed segmentation of the brain MRI images for detection of tumors using clustering techniques. A cluster can be defined as a group of pixels where all the pixels in certain group defined by a similar relationship. Clustering is also known as unsupervised classification technique. The name unsupervised classification because the algorithm automatically classifies objects based on user given criteria. Here K-means clustering algorithm for segmentation of the image followed by morphological filtering is used for tumor detection from the brain MRI images. The proposed block diagram is as shown.

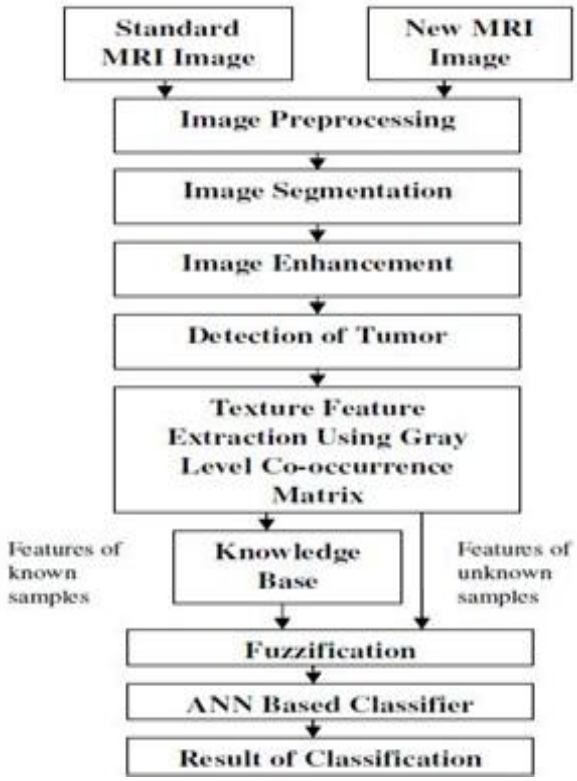


Fig : Proposed block diagram

MRI scans of the human brain forms the input images for our system where the grey scale MRI input images are given as the input. The preprocessing stage will convert the RGB input image to grey scale. Noise present if any, will be removed using a median filter. The preprocessed image is given for image segmentation using K-means clustering algorithm. As there are chances of occurrence of misclustered regions after the application of K-means clustering algorithm, we have proposed morphological filtering which is performed after the image is segmented by K-means clustering algorithm.

**Tumor Identification:** The major role of this application is to identify the tumor in the brain image and reconstruct the area which the tumor is affected and based on the threshold value the system will identify whether the image is affected by the tumor or not. Following are the functionality which is involved in the tumor identification module.

**Segmentation:** K-Means algorithm is used to implement the segmentation of the MRI brain image. Clustering can be considered the most important *unsupervised learning* problem so, as every other problem of this kind, it deals with finding a *structure* in a collection of Un-labeled data. A loose definition of clustering could be "the process of organizing objects into groups whose members are similar in some way". A *cluster* is therefore a collection of objects which are "similar" between them and are "dissimilar" to the objects belonging to other clusters.

**Reconstruction:** The affected area will be selected and as a cluster and constructed as an image and it is displayed in the label. Based on the constructed area threshold values will calculated and the tumor identification process will performed based on the threshold values. Our system will show the option pane message dialog contain the image affected or not.

**Testimony:** The report is generated based on the affected and the unaffected image. The users have to select the option the affected or un affected patients. The reports contain the patient id and the name of the candidate.

**Morphological Filtering:** Morphology is the study of shapes and structures from a scientific perspective. Morphological filters are formed from the basic morphology operations. A structuring element is mainly required for any morphological operation. Morphological operations operate on two images, structuring element and the input image. Structuring elements are small images that are used to probe an input image for properties of interest. Origin of a structuring element is by the Centre pixel of the structuring element. In morphology, the structuring element defined will pass over a section of the input image where this section is defined by the neighborhood window of the structuring element and the structuring element either fits or not fits the input image. Wherever the fit takes place, corresponding image that represents the input image's structure is got and suppression of the geometric features of the input image that doesn't fit the structuring element's

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neighborhood takes place. Two main morphology operations are erosion and dilation where erosion results in the thinning

of the objects in the image considered and dilation results in thickening of the objects in the image .Dilation uses the highest value of all the pixels in the neighborhood of the input image defined by the structuring element and erosion uses the lowest value of all the pixels in the neighborhood of the input image.

## V. EXPERIMENTAL RESULTS

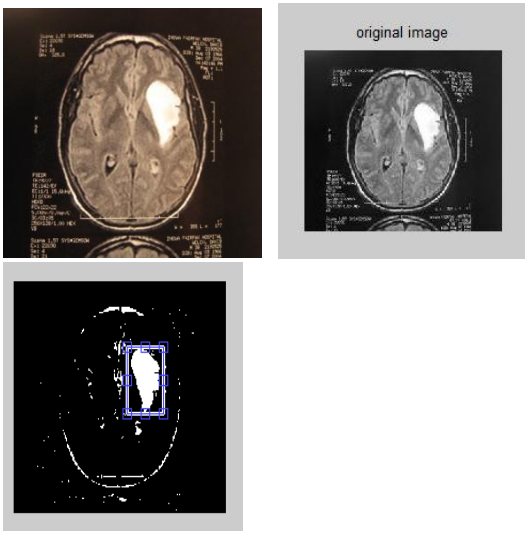


Fig : Affected area detection using K-Means Algorithm

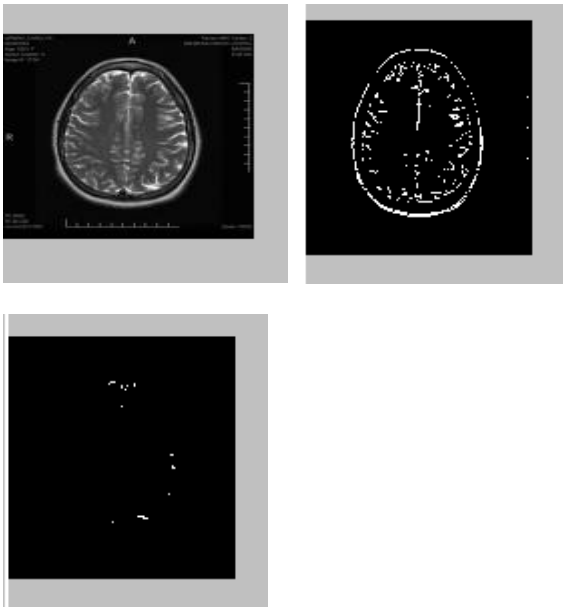

Fig : Non-Affected area detection using K-Means Algorithm

## VI. FUTURE SCOPE

Future research in the segmentation of medical images will lead towards improving the accuracy, exactness, and computational speed of segmentation approaches, as well as minimizing the amount of manual interaction. These can be improved by incorporating discrete and continuous-based segmentation methods. Computational effectiveness will be crucial in real-time processing applications. Segmentation methods have proved their utility in research areas and are now emphasizing increased use for automated diagnosis and radiotherapy. These will be particularly important in applications such as computer integrated surgery, where envision of the anatomy is a significant component.

## VII. CONCLUSION

Segmentation of brain image is imperative in surgical planning and treatment planning in the field of medicine. In this work, we have proposed a computer aided system for brain MR image segmentation for detection of tumor location using K - means clustering algorithm followed by morphological filtering. We were able to segment tumor from different brain MRI images from our database.

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