Brain Tumor Segmentation and Clustering using K-Mean Clustering and Fuzzy C-Means clustering

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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.

Keywords: Abnormalities, Magnetic Resonance Imaging (MRI), Brain tumor, Pre-processing, K-means, fuzzy c-means, Thresholding.

1. INTRODUCTION

This work deals with the concept for brain tumor segmentation and finally the detection of brain tumor and risk of disease. Normally the anatomy of the Brain can be viewed by the MRI scan or CT scan. In this paper the MRI scanned image is taken for the entire process. The MRI scan is more comfortable than CT scan for diagnosis. It is not affect the human body. Because it doesn't use any radiation. It is based on the magnetic field and radio waves. There are different types of algorithm were developed for brain tumor detection. But they may have some drawback in detection and extraction.

1.1 Background

In this work, two algorithms are used for segmentation. K-means clustering algorithm and Fuzzy C algorithm. So it gives the accurate result for tumor segmentation. Tumor is due to the uncontrolled growth of the tissues in any part of the body. The tumor may be primary or secondary. If it is an origin, then it is known as primary. If the part of the tumor is spread to another place and grown as its own then it is known as secondary. Normally brain tumor affects CSF (Cerebral Spinal Fluid). It causes for strokes. The physician gives the treatment for the strokes rather than the treatment for tumor. So detection of tumor is important for that treatment. The lifetime of the person who affected by the brain tumor will increase if it is detected at current stage. That will increase the lifetime about 1 to 2 years. 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 paper we focused on detection of brain tumor with the help of Brain MRI images and predict 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. Most brain tumor can be cured if found and treated early.

1.2 Motivation

A person who was affected by any kind of tumor has an increased risk of developing another brain tumor of any type. 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. Another risk factor of Brain tumor as well as other diseases is taking any camo therapy. A person who has taken any therapy is responsible for occurring different kinds of disease compare to other people who don't take any therapy. Day by

day the number of brain tumor person is increasing rapidly because of unconsciousness. The Objective of this work is to contract such a tool which can tell people about his/her approximate condition about brain tumor ,that is he or she in risk or not and how much? The developing platform for the detection is java. At the end, we are providing systems that detect the tumor and its shape and disease details from the given area of tumor.

1.3 Goal

MR imaging has become a widely-used method of high quality medical imaging, especially in brain imaging where MR's soft tissue contrast and non-invasiveness are clear advantages. MR images can also be used to track the size of a brain tumor as it responds (or doesn't) to treatment. 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.

After researching a lot statistical analysis which is based on those people whose are affected in brain cancer some general Risk factors and Symptoms have been discovered.

The risk factor of Brain tumor as well as other diseases is taking any camo therapy. A person who has taken any therapy is responsible for occurring different kinds of disease compare to other people who don't take any therapy.

Day by day the number of brain tumor person is increasing rapidly because of unconsciousness.

1.4 **Objective**

1. Identify the brain tumor on given image.
2. Detect the brain tumor part in given image.
3. Calculate the area of brain tumor.
4. Identify the stage of tumor.
5. Predict the accurate disease from the given area of tumor.

1.5 Problem Statements

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.

2. LITERATURE SURVEY

SN.	Author and Title	Proposed System	Implemented Concepts
1.	Samir Kumar Bandhyopadhyay, Tuhin Utsab Paul , **"Automatic Segmentation of Brain Tumor from Multiple Images of Brain MRI"**	This paper has 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.
2.	A. Meena, K. Raja, " **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 Tatiraju, Avi Mehta, " **Image Segmentation using k-means clustering, EM and Normalized Cuts"**	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.
4.	Ajala Funmilola, " **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, 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, **“Systematic image processing for diagnosing brain tumors: A Type-II fuzzy expert system”**	This paper proposed a dip study of brain tumor. It describes different type of diagnosis approaches.	A brief knowledge about tumor like glial tumor which cover 30 % of all brain tumors.
7.	Samarjit Das , ” **Systematic image processing for diagnosing brain tumors: A Type-II fuzzy expert system approach”**	In 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.
8.	Vignesh Rajesh, ” **brain tumor segmentation and its area calculation in brain MRI 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, and finally, threshold segmentation.	The implemented method 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 Singh, ” **A Study Of Image Segmentation Algorithms For Different Types Of Images”**	In this paper the author gives a study of the various algorithms that are available for color images, text and gray scale images.	Implementation of segmentation technique those are color-based-segmentation, pixel-based segmentation and edge-based segmentation.
10	payal mistry, shagun akhauri, sayali patil, s.p.tondare, ” **segmentation of brain tumor and its area calculation in brain MRI images using k-mean clustering and fuzzy c-mean algorithm”**	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

3. EXISTING SYSTEM AND LIMITATIONS

The existing method is based on the thresholding and region growing. The thresholding method was ignored the spatial characteristics. Normally spatial characteristics are important for the malignant tumor detection. In the thresholding based segmentation the image is considered as having only two values either black or white. But the bit map image contains 0 to 255 gray scale values. So sometimes it ignores the tumor cells also. In case of the region growing based segmentation it needs more user interaction for the selection of the seed. Seed is nothing but the center of the tumor cells; it may cause intensity in homogeneity problem. And also it will not provide the acceptable result for all the images.

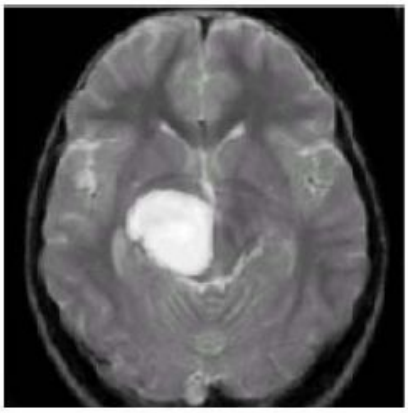


Fig.1 input image Thresholding

Fig.2 output Image for Thresholding

Fig.1 is the input image for thresholding. From the MR image itself we can see the tumor area but it is not enough for further treatment. For that it is given to the thresholding process. Fig2 is the output image for the thresholding. It consists of only two gray values .That is white as 1 and black as 0. The background value is assigned to binary value 0 and object gets the value 1. So we cannot extract the tumor from the image. This is the main drawback of the existing system. Due to that we go for the proposed method for tumor segmentation.

Disadvantages of Existing System:

1. The main disadvantage of existing system is it consists only two gray values which are not sufficient to extract the tumor from the image.

4. PROPOSED SYSTEM

The proposed system has mainly four modules: preprocessing, segmentation, Feature extraction, approximate reasoning and classification. Pre processing is done by filtering. Segmentation is carried out by advanced K-means and Fuzzy C-means algorithms. Feature extraction is by thresholding and finally, Approximate reasoning method to recognize the tumor shape and position in MRI image and predict the disease risk from result area of brain tumor. I.e. finally implement a system to predict Brain tumor risk level which is easier, cost reducible and time savable.

The proposed method is a combination of two algorithms.

Advantages of Proposed System

1. It consist two algorithms for clustering and classification which effectively able to extract tumor from image and gives the actual final result.
2. This proposed system effectively able to extract all the spatial characteristics of an Image.

4.1 Proposed System Architecture

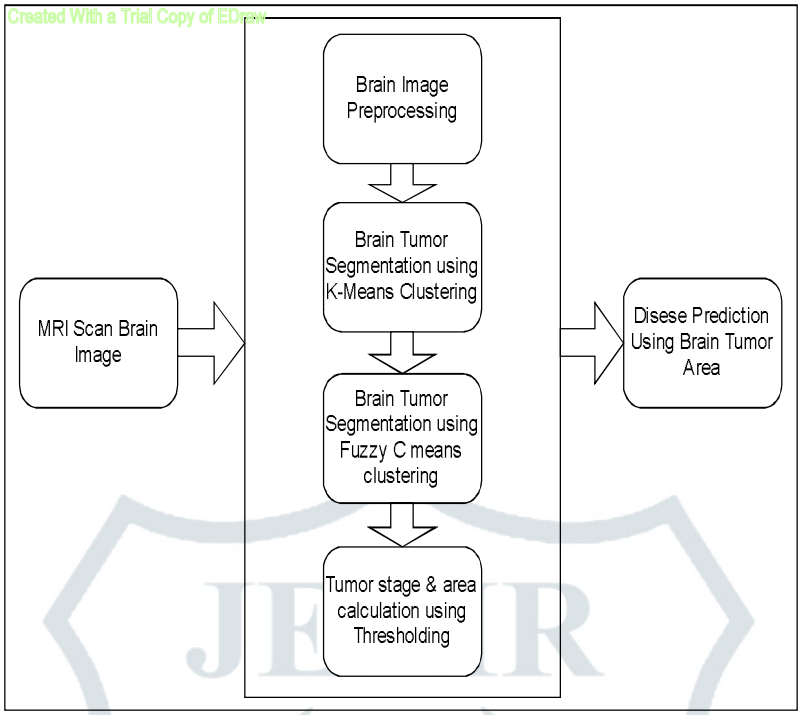


Fig.3 Block diagram of proposed method

4.2 Modules

Module Description:

User Model

In User model user can login when he is already register and can upload the MRI scan brain image and then process to detect the brain tumor in the uploaded image and predict another disease risk details from result of area of tumor.

4.3 MATHEMATICAL APPROACH

Set Theory:

S={s, e, X, Y,}

Where,

s = Start of the program.

- Preprocessing.
- Segmentation using K-means.
- Segmentation using Fuzzy c-means.
- Thresholding.
- Calculate area of tumor.
- Identify the stage of tumor.

e = End of the program.

Resultant output provided by the input MRI scan brain image.

X = Input of the program.

Input should be Image file.

Y = Output of the program.

Image will be uploading. Then the further processing will be done and finally appropriate result will provided.

X, Y U

Let U be the Set of System.

U= {Client, I, K, F}

Where, Client, I, K, F are the elements of the set.

Client= User

I= MRI scan brain Image

K= K-means clustering.

F= Fuzzy C –means clustering

SPACE COMPLEXITY

The space complexity of an algorithm is the maximum amount of space used at any one time, ignoring the space used by the input to the algorithm.

TIME COMPLEXITY

Check No. of image file 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.

FAILURES AND SUCCESS CONDITIONS

Failures:

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

Success:

Search the required information from available in Datasets.

User gets result very fast according to their needs.

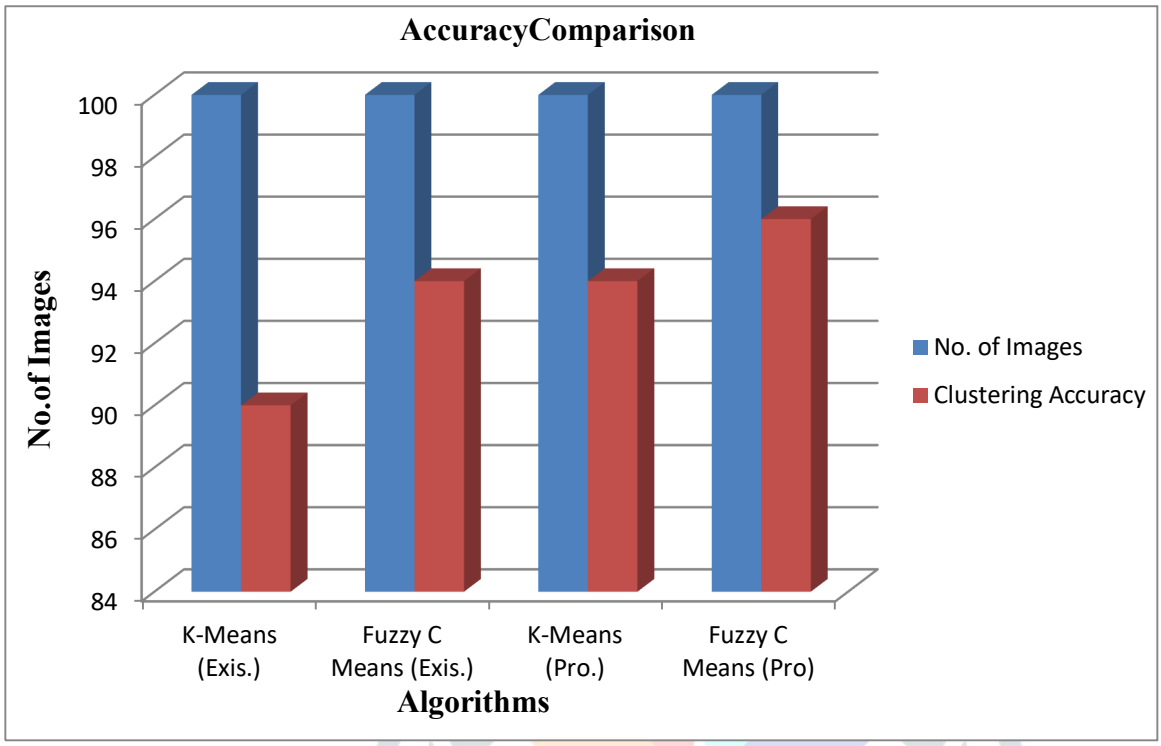
So the above mathematical model is NP-Complete.

5. RESULTS AND DISCUSSION

Researcher compared the existing and proposed result and shows graphically. Let see the following graph and table shows the segmentation accuracy result of both clustering techniques mainly k-means clustering technique and fuzzy c means clustering respectively. The overall existing segmentation accuracy of k means technique and fuzzy c means clustering are 90% and 94% resp. So our proposed system segmentation accuracy is 94% and 96% respectively.
So this works gives better segmentation result compare to existing method.

5.1 Data set

In our proposed system we used MRI scan brain image data which is collected from the city hospital which contains different patient MRI scan brain images.



Graph: 5.1 Brain Image Clustering Accuracy Graph

Table: Brain Image Clustering Accuracy

	No. of Images	Clustering Accuracy
K-Means (Existing)	100	90
Fuzzy C Means (Existing)	100	94
K-Means (Pro.)	100	94
Fuzzy C Means (Pro)	100	96

5.2 Methodological evaluation

Metrics of evaluation

Researcher evaluated our proposed approach with respect to the parameters such as:

1. Proposed system considers the image file format and processing operation will perform on that.

2. System should work on MRI Scan brain image to increase the image segmentation performance in system and show the final segmentation result with area and stage of brain tumor.

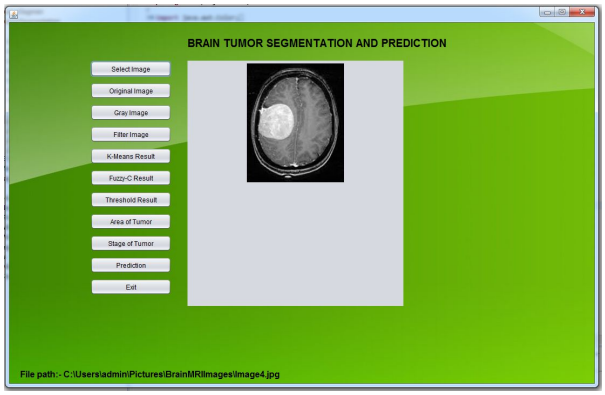


Fig: 4 Input image

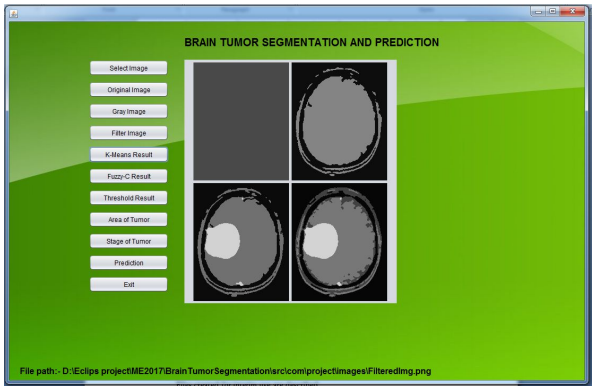


Fig: 5 Result of K-Mean clustering

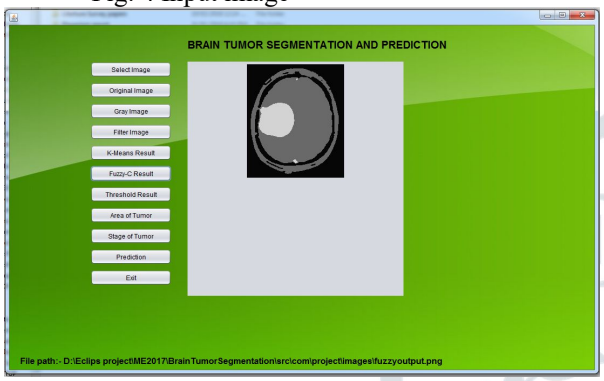


Fig: 6 Result of fuzzy c-mean Clustering

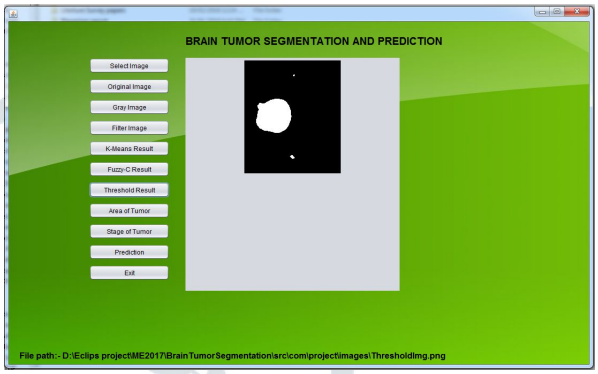


Fig: 7 Result of Thresholding

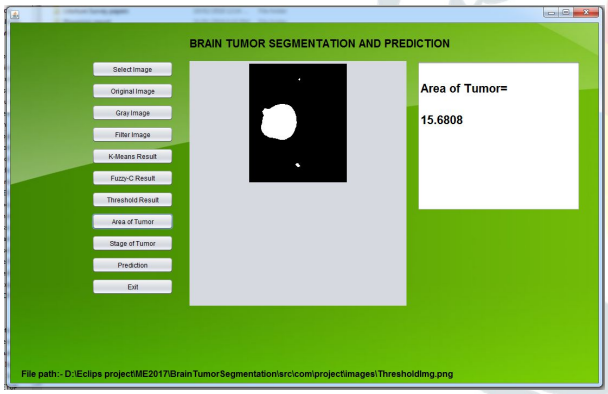


Fig: 8 Area of tumor

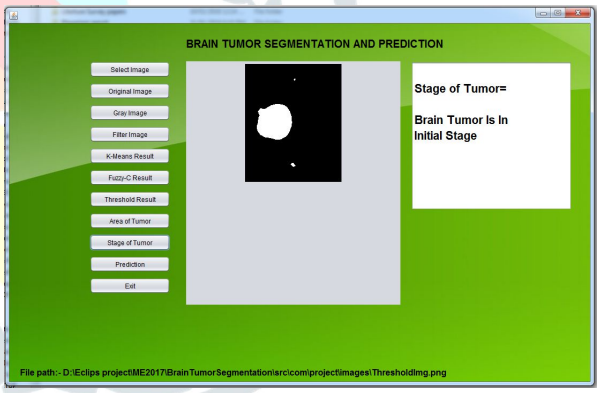


Fig: 9 Stage of tumor

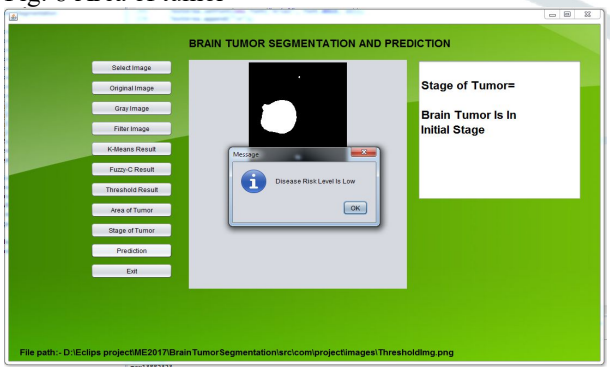


Fig:10 Prediction

Observations:

Fuzzy C means and K Means Clustering are used to compare individual performance with the proposed method and the result of all are compare and we find that the proposed system having less errors for brain image segmentation in the system and also system successfully count the area of tumor and stage of tumor.

CONCLUSION

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 a 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 malignant tumor and thresholding of output in feature extraction. Finally, approximate reasoning for calculating tumor shape and position calculation and finally to classify 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. In future, we can expand this work by using In future 3D assessment of brain using 3D slicers and work on them.

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